MAGNETICALL Aduertiſements:

P-16-1

OR

DIVERS PERTINENT obſeruations, and approued ex-*periments, concerning the natures and pro-*perties of the Load-ſtone.

Very pleaſant for knowledge, and moſt needfull for practiſe, of trauelling, or fra-ming of Inſtruments fit for Trauellers *both by Sea and Land.*

BIB. ANT. CAD.

Whereunto is annexed a breife Diſcouerie of the idle Animaduerſions of MARK RIDLEY Dr. *in Phyſicke, vpon this Treatiſe entituled* Magneticall Aduertiſements.

ACTS 17. 26.

He hath made of one bloud all nations of men for to dwell on the face of the earth, and hath determined the times before appointed, and the bounds of their habitation, that they ſhould ſeeke the Lord, &c.

The ſecond Edition.

LONDON,
Printed by *Edward Griffin* for *Timothy Barlow*, and are to be ſold at his ſhop in *Pauls* Church-yard, at the ſigne of *Time*. 1618.

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TO THE RIGHT WORSHIPFVLL, DISCREET, and learned Gentleman, Sir DVDLEY DIGGES *Knight.*

SIR, the nature, powerfulneſſe, and ſtrange properties of the *loadſtone* are ſuch, that the more they are known, the more they are iuſtly admired in their moſt liuely expreſsing that infinite power, and goodnes of our God, who hath created ſo precious a Iewell for the profitable vſe of man, and for the enlarging, and ſetting forth of his owne glory. Into the ſearch of which admirable and ſecret vertues

my ſelfe by the ſpace of theſe forty yeeres, haue ſomewhat entred (as my leaſure and occaſions would ſerue, and at by times) partly by reading other mens writings, and partly by my owne induſtrie and practize: Whereby what I haue collected, and found, this little Treatiſe will ſhew. Which, whether it be any thing, or nothing, I do referre vnto the iudicious *Readers* conſideration, but in ſpecial to your fauorable conſtruction, and good acceptance.

Many yeeres ſince diuers of my good friends, and among them ſome honourable perſons, were very deſirous that I ſhould publiſh ſuch obſeruations as I had collected, both before, and alſo after the ſetting forth of D. *Gilberts* booke: And none more earneſt herein then D. *Gilbert* himſelfe, vnto whom I communicated what I had obſerued of my ſelfe, and what I had built vpon his foundation of the *Magnetiſme* of the earth. Both which hee liked well and wiſhed me to publiſh them, as I remember at the time of our priuate conference, as may further appeare by letters that I receiued from him; which I haue to ſhew vnder his owne hand.

But

But aboue all others, the perſwaſions of that learned honourable Gentleman, *Sir Thomas Challenor*, late Chamberlaine vnto the Mirrour of honour Prince *Henry* preuailed moſt with me. Vnto whom I was all the time that I attended that Prince his highneſſe, for his loue and curteſie, much beholding. Whereupon about ſeauen yeeres ſince I deliuered vnto him this Treatiſe, finiſhed almoſt as now it is, ſauing ſome few additions vpon neceſſary occaſions. But that Copie was either miſlaied or embeſeled, that he loſt it; About three yeeres ſince he ſent earneſtly vnto mee for an other Copie: which alſo he receiued, promiſing me by his letters, that within three months hee would put that to the preſſe, and that it ſhould be carefully and correctly performed: But what is become euen of that alſo I know not: Only this I am ſure of that I haue met with many portraitures of my Magneticall implements, and diuers of my propoſitions ſet abroad in print in another mans name, and yet ſome of them not rightly vnderſtood by the partie vſurping them.

Now that it hath pleaſed God to take

Sir Thomas Challenor and that vpon enquirie I can heare no tidings of thoſe my loſt labours, and knowing that diuers are very deſirous to ſee them, I haue once againe reuiued my ſcattered papers, collected them together, & made choice of your ſelfe to whom to entitle (according vnto our vſuall curteſies) theſe *magneticals*; your worthy ſelfe I ſay in many reſpects: Firſt, becauſe your rare learning ioin'd with ſo great pietie, accompanied with ſo pleaſing a carriage of your ſelfe towards euerie man is ſuch, as cauſeth all good men which know you, to loue you, by force of a naturall ſympathy not vnlike the appetite of concourſe & coniunction whereby our very Magnets doe affect their proper obiects. And this was verie conſpicuous in our renowned iudicious Prince *Henry*, who loued you ſingularlie well for your vertues, and delighted no leſſe to conferre with you for your knowledge in matters appertaining vnto Diſcoueries and Coſmographicall learnings, in the which his highnes was more then vulgarly skilfull.

Another is, the glorious fauour which I ſee reflected vpon you from that moſt reuerend and

and ſingular ornament of our Church and State, reioycing in Gods bleſsing of his labors in your education: like as God hath hitherto bleſſed him in all things, and not onely my prayers and ſuch as I am who are ſo much bounden vnto him, but the praiers of many thouſands that neuer ſaw him, will not ceaſe to beſeech the Almightie long to preſerue him. and alwaies to proſper him in his godly proceedings: Wherefore this extraordinary reſpect which he hath vnto you, both is and muſt be a commanding motiue vnto mee to ſhew my good will by the beſt poore meanes that I can toward you.

Yet one more I haue, which is this: That whereas a worthy ſocietie of Gentlemen and Marchants is very highly and iuſtly commended and honoured of all men, for their great charges in their conſtant and indefatigable proceedings, for diſcoueries of vnknown paſſages to new Countries and Nations, for the further aduancement of Gods glorie, the honour of our King, and principall benefit of the whole Kingdome; In remembring of thoſe honourable attempts, you muſt in no wiſe be

forgotten

forgotten, and eſpecially in a Treatiſe mentioning the vertues, and properties of the *Loadſtone*, being the leader and guide to theſe admirable exploits, who beſides your ſouud knowledge herein, doe with great conſtancie ioine both your purſe and counſaile for the atcheiuing of them, yea and that without expectation, or hope of priuate gaine, but onely of your noble genorofitie, knowing full well, that the aduancement of Gods glorie is abſolutely of it ſelfe the greateſt gaine with a contented minde; Wherewith, he that onely is all-and ſelfe-ſufficient, enrich you more and more in this world, and to your eternall happineſſe, moſt abundantly and perfectly ſatisfie you, by making you drinke of the riuer of his pleaſures in the world to come; Amen.

Yours with all

hearty affection

WILLIAM BARLOWE.

THE PREFACE to the Reader.

THat wonderfull propertie of the body of the whole earth, called the Magneticall vertue (most admirably found out, & as learnedly demonstrated by Doctor Gilbert Phisitian vnto our late renowned Soueraigne Queene Elizabeth of happy memory) is the very true fountaine of all Magneticall knowledge. So that although certaine properties of the Loadstone were knowne before, yet all the reasons of those properties were vtterly vnknowne, and neuer before reuealed (as I take it) vnto the sonnes of men. And although as yet many doe doubt and mistrust that the earth it selfe hath no such vertue, I doe nothing wonder at it, because before I read his learned workes, and had tried many of his experiments with mine owne hands, and had conferred with great Trauellers, and perused the obseruations of our chiefest Nauigators both for their variations, and declinations, I neuer beleeued it my selfe. But this I may truely affirme that searching with diligence his first fiue bookes, and making triall of all those propositions which I iudged to be of importance, I alwaies found the maine drift, touching this point, certaine, constant, and agreeable to the diligent obseruations of diuers men of experience; although in some other

matters of the Loadſtone *his experiments and mine did ſometimes diſagree, as I ſignified to himſelfe in his life time, which he did take in very good part, as I haue yet his owne letters to ſhew. But concerning his ſixth Booke entreating of the motion of the earth, I thinke there is no man liuing farther from beleeuing it, than my ſelfe, being nothing at all perſwaded thereunto, by the reaſons of other men, which he alledgeth, and as little or leſſe (if it were poßible) by thoſe his inventions, endeuouring to proue the motion of the earth by the earthes* Magneticall *force and vertue.*

Amicus Socrates, Amicus Plato, ſed magis amica veritas *is the onely cauſe why I doe embrace his iudgment, in the one, and refuſe it in the other, in matters of this nature following this Rule:*

Nullius addictus iurare in verba Magiſtri.

But to returne to the Magnetiſme *of the whole earth, I doe hold it to be one of the rareſt, and excellenteſt inventions, and the beſt followed by him, with euident proofes and of the greateſt conſequence for the admirable art of Nauigation that euer was found out ſince the Creation of the world, ſo that it may well be ſaid of him touching that point.* Exegit monumentum ære perennius

Regaliq; ſitu pyramidũ altius, *in reſpect of the manifold vſe and commoditie thereof in the doings of this life. The properties of the* Magnet *ſeruing not onely for Sea-affaires, but alſo for trauelling by Land in waſte and ſolitarie deſerts, for moueable Sun-dyalls in all places of the world, for the more ready and exact Chorographie of any Countrey, or the true plotting of any ground, and for the following of any Minerall veyne that is voide of Iron vnder the earth, for Pioners and diggers in Mines.*

And

And in all this appeareth the wonderfull power and goodnes of God who hath vouchsafed to reueale vnto the weake knowledge of man now towards the end of the world, his admirable treasure, before vnknowne, of his powerfull Creation, by effect so plaine vnto the meaneſt capacitie: And that out of a baſe, contemptible and dead creature, as it ſeemeth to be, and yet filled with ſuch excellent and wonderfull vertue, that all the Gemms of the world, haue not the like; neither if it were wanting could ſupply the want thereof, or countervaile the benefit that it bringeth to the life of man.

Claudianus *(a famous Poet) well nere twelue hundred yeares ſince, ſaith as much in commendation of the* Magnete, *when as yet the Sereditticall or Iron-drawing property thereof was onely known.*

—— Lapis eſt cognomine Magnes
Decolor, obſcurus, vilis &c.

And againe,

Sed noua ſi nigri videas miracula ſaxi,
Tunc ſuperat pulchros cultus, & quicquid Eois
Indus littoribus rubra ſcrutatur in algâ.

But what would he not haue ſaid, had hee ſeene the true cloſſet indeed of all Magneticall *miracles vnlocked, and in glorious manner ſet wide open as now it is at this day.*

Many of our Nation both Gentlemen and others of excellent witts and louers of theſe knowledges, not able to read Doctor Gilberts *Booke in Latin, haue bin (euer ſince the firſt publiſhing thereof) exceeding deſirous to haue it tranſlated into Engliſh, but hitherto no man hath done it, neither (to my knowledge) as yet goeth about any ſuch matter, whereof one principall cauſe is that there are very few*

that vnderſtand his Booke, becauſe they haue not Loadſtones *of diuers formes, but eſpecially round ones: Alſo ſuch verſory needles fitly framed, and artificially placed vpon their pins, and other ſuch implements, as he doth there preſcribe, wherewith being furniſhed, as they read his propoſitions in words, they might ſtill ſee the truth of them in the things themſelues, according as himſelfe forewarneth that theſe skills muſt be learned* Ex rebus ipſis non ſolum ex libris, *out of the things themſelues and not onely out of Bookes. A ſecond cauſe may be for that there are diuers words of Art in the whole courſe of this booke proper to this ſubiect, and fit to the explanation of his figures and diagrammes which cannot be vnderſtood but by the helpe of the* Mathematicks, *and good trauelling in the* Magneticall *practiſe.*

Moreouer his alleadging of other mens erroneous opinions concerning this Argument, and his confutations thereof, may ſeeme at the firſt to a yong beginner ſomewhat harſh and tedious. Both which I ſuppoſe in the Engliſh tranſlation (if any were) might well be omitted: like as in this my Treatiſe I thinke it not altogether ſo pertinent to handle them all.

And a ſport it is to behold diuers of ſmart witts, and ſuch as weene themſelues to be ſo great Clerkes, that they will aduenture boldly to diſpute de omni ſcibili, *how miſerably they runne their witts on ground, when onely by a ſlender reading ouer of his booke, or moſt commonly ſome part thereof, they will take vpon them to define, controule, and diſcourſe of thoſe matters fearing nothing more than that of the Poet,*

—— mihi turpe relinqui eſt
Et quod non didici ſane neſcire fateri.

For

For being vrged by diuers of our Gentlemen (among whom these knowledges are had now a daies in some request) somewhat they must speake, which must be either superciliously to scorne such things, as vanities, because themselues vnderstand them not, or else with slender ostentation to blunder out their masked ignorance, supposing it to be inough for them to say that they haue read Dr. Gilberts *Booke, and so to vse that for a* Supersedeas *to acquite them of any farther inquirie. But many, being now at length weary to take such counterfeit shewes for good payment, doe seriously seeke to haue some sound knowledge of the things themselues, and not to depend vpon other mens extrauagant disputes, but to be their owne iudges in matters that concerne themselues, and are subiect to their owne senses and reasons, and especially because some of them must aduenture their whole estates, yea and also their liues vpon the right vnderstanding of some* Magneticall *conclusions.*

Wherefore vpon the earnest longing of certaine mine Honorable and Worshipfull freinds, and for the singular loue that I beare to the louers and practizers of the worthy Art of Nauigation, and to satisfie the commendable desires of such as like to haue some insight (though themselues be not practizers in these matters of admirable knowledge, and great vtilitie) I haue vndertaken to contriue all the cheifest points of this most necessary skill, and the vse of them in this short Treatise.

Not meaning to translate Doctor Gilberts *booke, but to take those thing out of it which I shall thinke fit for this purpose, which are onely the* Magnetisme *of the whole earth, and some of the consequents thereof, and to adde the rest of mine own industry: Wherin I may be bold after a-*

ſort to challenge a right, as hauing endeuoured to get ſome inſight in this argument (a matter well knowne to diuers) aboue the ſpace of twenty yeares ere Doctor Gilberts *booke ſaw light. And in very deed I communicated many of my obſeruations with him, aboue one whole yeare before he put it out in print. To be ſhort, of all that I ſhall ſet downe in this Treatiſe my requeſt is, that the Reader will admit nothing but that which ſhall be confirmed by good reaſon, or vndoubted experiments. And I purpoſe (God willing) to tye my ſelfe, as ſtrictly vnto this rule as euer any man did that hath written of the like argument, making it euen a matter of conſcienae to deliuer any thing herein for certaintie, that my ſelfe ſhall not know to be ſound. And ſo by this meanes ſhall I neither abuſe the Reader with any vntrue aſſertion, nor iniurie ſo certaine and ſo excellent a knowledge with any doubtfull or vnapproueable concluſions.*

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CHAP. I.

MAGNETICALL
Aduertiſements.

CHAP. I.
Of the magneticall power and force of the whole Globe of the Earth.

Oncerning the Magneticall force of the whole body of the Earth, I haue ſelected theſe experiments to proue it.

Take any peece of ſolid earth that hath ſome toughneſſe to hold together, and will abide the fire, as any ſort of clay, or bricke (which ſomtimes was clay) faſhion it in ſuch manner that it bee vniformely extended towards both ends (the Ouall or long figure is fitteſt for our purpoſe) put it into a fire of charcoles, increaſing the heat by little and little, and at the length with often blowing, make it throughly as red hot as you can: let

it remaine so for the space of halfe an houre, or more, that thereby all superfluous moisture may be consumed, and aduerse qualities separated from it, then take it forth, and let it coole of it selfe, being first set *North* and *South*, with either end answerable to the variation of the place, not paralell vnto the *Horizon*, but eleuated answerable to the *Latitude* as nere as you can. Certaine it is that this peece of earth thus ordered, will sensibly shew you that it hath true *Magneticall* vertue. But here before I proceed any farther I must deliuer vnto you a necessary obseruation: There are two kindes of *Attractions* (as they are commonly called) the one *Magneticall*, the other *Electricall*. The *Magneticall* hath alwaies speciall respect vnto the *North & South* points of the *Magnet* or *Magneticall* body. The *Electricall* body hath no manner of respect vnto any one point of the *Electricall* body, more than another: And by this difference these two kinds of *Attractions* are easily discerned; As also by this, looke what end of the *Magneticall* needle the one end of the *Magnet* doth draw, the other will chase away; but the *Electricall* body draweth alike at all ends. And thirdly after this sort, lapp this *Electricall* body in a paper and it will draw nothing at all, but interposition of brasse or of a stone wall within the orbe of the *Magnets* vertue, doth nothing weaken the same, or hinder his effect towards his peculiar obiect. Notwithstanding (to speake properly) *Attraction* pertaineth onely to *Electricall* bodies, because the whole *attractiue* vertue is onely in the *Electricall* body it selfe, and nothing at all in the thing that is attracted. The *Attraction*

(com-

(commonly ſo called) of the *Loadſtone* is rightly to be termed, *Concurſion*, *Confluence*, or *Coition*, becauſe it is the running or vigorous meeting together of two *Magneticall* bodies hauing a mutuall inclination the one to ioyne with the other, or by any other name, bearing like ſenſe. For the true knowledge thereof, being but lately as a ſtranger arriued amongſt vs, common vſe (*Quem penes arbitrium eſt, & ius & norma loquendi.*) hath as yet ſcant ſuted it, with a conuenient name to expreſſe this property; So that *Magneticall Concurſion* is neuer but betweene two bodies, ſuch as both of them are *Magneticall*; As of one *Loadſtone* with another, or of a *Loadſtone* with yron or ſteele, or yron oare if it be prepared, or betweene two peeces of yron or ſteele that are reuiued with a *Loadſtone*; for indeed the *Loadſtone* can but reuiue, and multiply *Magneticall* force in a body that naturally hath it in ſome meaſure before: but cannot infuſe it into any thing, that before is vtterly voide of it, as of mettals, in yron or ſteele, and not in gold, ſiluer, braſſe, &c. *Electrum* in this argument is named that which is either *Amber* in ſubſtance, or at the leaſt of the quality, and that *Amber*, being rubbed, hath, to take vp moats, feathers, ſtrawes, ſticks, and other ſmall things. The which property is alſo in ieate, brimſtone, hard waxe, (if it be ſmooth) and in infinite other things both naturall and compound: all which becauſe of that qualitie in this argument are termed *Electricall bodies*, and their taking vp of things is called *Electricall attraction*, hauing onely a ſlender reſemblance, and no truth of the *Magneticall* qualitie.

But that aboue-mentioned peece of earth, prepared in such sort as is before prescribed, will by *Magneticall concursion* shew it selfe to be a true *Magneticall* body. For the one end of the *Magneticall* needle will couet towards the one of the prepared masse, and flie from the other. And contrariwise also, though it will do both but weakely, not with power comparable to a naturall *Loadstone*, yet as truely as that. That end which cooled toward the *South*, will draw the true *North* end of the needle, and that end which cooled toward the *North* will draw the true *South* end of the needle. If so be as yet you will haue another infallible argument, doe thus: Marke what end draweth the *North* end of the needle, afterward put the new made *Magnet* into the fire againe, and when it hath been glowing for the space of halfe a quarter of an houre, take it out and coole it being placed with that marked end toward the *North*, most assuredly that end now will draw the *South* end of the needle, & the *North* end of the needle will shun it, which before approached vnto it. The reason here of is, because the fire hauing abolished all the former *Magneticall* qualitie of that masse wherewith it was in a contrary position affected in the former cooling, now leaueth it apt and fit to receiue any other new impression: which presently it taketh againe either regularly, if in the cooling it be placed with the ends to the *North* and *South*, or (if it be placed otherwise) confusedly, by the *Magneticall* force and vertue of the whole body of the earth, by regular and confused, this is the meaning. Take any lump of earth, or any brick-bat ordered in this sort, certaine

taine it is that this lumpe of earth or bricke-bat hath some *magneticall* vertue therein, yet so feeble and weake, that our sence cannot discerne it, because of the vnfitnesse of the forme, and the confused dispersion of that weake force, through the whole body thereof. Then suppose you will bring either of these into an extended ovall forme, which is most apt (as before I said) for any body *magneticall* to shew his force, yet this will helpe it nothing at all of it selfe, as you may easily make experience in euery *Loadstone*. For if you take a *loadstone* of a confused forme, it is not inough to bring it into a conuenient ovall, except with diligence you reserue the points of the North and South in the two ends thereof, for if you leaue the points in the sides you marre it with this ovall forme. For the stone will not lightly be of one quarter of the force, it was of before; For the ovall forme giueth it no vertue, but is the fittest for it to shew the vttermost of that strength, which of it selfe it had before, if you obserue the due points, and not otherwise. But in this earth and bricke it is not possible to finde the due points in such sort as you may in a *Loadstone*, because of the weakenesse of the *magneticall* force therein contained. And therefore you cannot bring that into a regular ovall forme, to haue the due points in the very ends. But if you first make it into an ovall forme, and by the fire take away the confused *magneticall* force, and all other peruerse qualities thereof, that being by nature a *magneticall* body in his cooling before specified, receiueth presently by that vnresistible power of the earth, his *magneticall* vertue, according

vnto that forme, and will regularly haue his due points precisely in the ends, without any confusion. *Iohannes Baptista Porta Neapolitanus*, writeth that hee did make triall of the way that *Paracelsus* hath set downe for to increase the vertue of a *magnet*, namely to heate him red hot in the fire, and to quench him in the oyle of *Crocus Martis*: And *Baptista Porta* saith, that hee found it a detestable falshood. For saith hee, he is so farre from increasing his vertue, as that (being once red hot) he looseth all his own, past all recouery. But for all this that hee saith, I doubt whether *Paracelsus* be iustly reproued or not, for by mine owne experience I know that the heating of a *Loadstone* vntill he be red hotte doth weaken a *loadstone*, but taketh not away all his force, and in my triall hereof I found a very manifest proofe of the *magnetisme* of the earth, which I thought necessary for to insert in this place. I haue made this triall of Fragments of *magnets* of diuers kindes, and also of diuers kindes of Iron Mines which are next in degree vnto *magnets*, namely after this sort. Heate him in the fire by little and little (for feare of breaking) vntill he be red hotte, then take him out and let him coole, then marke (with chalke or what you please) those parts that respect the North and South and you shall finde those marked places, the North, and South Poles of the *Magnet*: put him into the fire againe, vntill he be red hotte, and coole him contrarily, and you shall haue the contrary effect. Therefore if *Baptista Porta* did make his triall with a *Loadstone* very long in forme, and chaunced (for Master *D. Gilberts* mistery of the Earths *magnetisme*, was not then

then reuealed) for to coole him in his oyle of *Crocus Martis* with his ends East and West, the axis of the ſtone being then ouerthwart in the middle, it were no maruell if he found no force in the ends. And I do not thinke it improbable, but that *Paracelſus* way may doe ſome good rightly vſed. Doctour *Gilbert* writech that ſome Iron mine, will affect a *magneticall* needle, as it is of it ſelfe, being vnprepared by fire: but as yet I neuer could finde any ſuch, but this I haue often tried, that it being of no manner of *magneticall* vertue of it ſelfe no more then a flintſtone vnprepared by fire, being made red hott, and cooled, is preſently impregnated with very apparant *magneticall* vertue, according to the ſcituation that hee is cooled in, and although you heate and coole him often, and diuers waies, he will ſtill keepe his vertue, according to the ſcituations, of his cooling. And ſome Iron Mines I haue found, which being but in this ſort prepared haue had as ſtrong force as ſome naturall *magnets* haue had. It is the goodneſſe of the *Loadſtone* ioyned with a fit forme that will ſhew great force. For as a very good forme with baſe ſubſtance can doe but very litle, ſo the ſubſtance of the *Loadſtone* bee it neuer ſo excellent, except it haue ſome conuenient forme, is not auaileable. For example, an excellent *loadſtone* of a pound waight and of a good faſhion, being vſed artificially, may take vp foure pounds of Iron; beate it into ſmall pouder, and it ſhall bee of no force to take vp one ounce of Iron; yea I am very well aſſured that halfe an ounce of a *Loadſtone* of good faſhion, and of like vertue will take vp more then that pound will doe being

being beaten into powder. Whence, (to adde this by the way) it appeareth manifestly, that it is a great error of those Phisitions and Surgeons, which to remedy ruptures, doe prescribe vnto their Patients to take the pouder of a *Loadstone* inwardly, and the small filing of iron mingled in some plaister outwardly: supposing that herein the *magneticall* drawing should doe great wonders. Whereas they consider not that the stone being dissolued into powder, euery little particle of the dust hath two points contrarie, the one drawing to, the other repelling and putting from: and so being thus confounded by a contrarie working doth much more harme, then good with his *magneticall* quality. As for the astringent, and drying properties of the *Loadstone* I leaue them to the diligent obseruation and iudgment of the skilfull in phisicke. But to returne to our purpose, and to alledge this also, besides the former manifest proofe, if the earth were not by nature a *magneticall* body, the afore mentioned peice of earth could not receiue from a *Loadstone* any *magneticall* power: But most certaine it is, and by many vndoubted experiments confirmed, that it will euidently receiue *magneticall* power, from a *Loadstone*: therefore it is manifest that the earth is by nature a *magneticall* body. Furthermore, as among all the mettals iron doth incomparably more resemble the earth in substance then any other doth, it likewise doth more participate with the earth in quality, and principally in the *magneticall* peculiar property hereof, as notorious experience declareth, yea euery peice of iron Oare, being naturally (as D. *Gilbert* sheweth

ſheweth) a *magnet*, although of feeble force, and all *magnets* being a kinde of iron Oare, is the very cauſe, that onely iron or ſteele, and no other mettall is capable of that vertue, namely to haue that reuiued, and multiplied by the vicinity of a *magnet*, which at the firſt in ſome meaſure, was originall in it ſelfe, as it is aforeſaid; It is alſo well knowne, that the *magnet* is a Stone moſt commonly of inuincible hardneſſe, nothing inferiour to any iron or ſteele of the excellenteſt ſort, notwithſtanding ſometimes wee ſee of them that are nothing, but a dry lumpe of earth, and yet of thoſe alſo ſome ſtronger in vertue, then diuers of the hard ſtony ones are: Which earthly *magnets* if a man aſſay to bring it into a faſhion by grinding on a grinding ſtone (according to the common vſe) they will conſume into very mudde in the water. Now (to drawe towards an end of this matter) albeit the *magneticall* vertue be moſt eminent in the *magnet*, as in the preciſe and perfect ſubiect thereof: yet is the ſelfe ſame quality, in a meaner degree, euidently to be diſcerned in euery peice of earth, prepared and ordered (as is aforeſaid) yea although it be not cooled with his ends North and South, that it may take his *magneticall* force from the vertue of the earth, for if you coole it with his ends but Eaſt and Weſt and ſet two *Loadſtones* in the cooling, the one at one end and the other at the other end, it will receiue a ſenſible and apparant *magneticall* vertue according to thoſe points of the *Loadſtone* that were applied vnto it, namely that end which was next the South point of the *Loadſtone* will haue a North properly, and that end that was next the North

point, will haue a South property: yea if you set the North part of two *loadstones* vnto each end, both ends of this new made *magnet* will haue a South property; And contrariwise if you apply the South ends of two *magnets*, both his ends will haue a North property; And those properties before mentioned will shew themselues to be *magneticall*, because whether end of this new *magnet* draweth any one end of a *magneticall* needle, the same will chase away the other: which is proper only vnto *magnets*, and *magnetical* bodies. After the like sort, only by application of two strong *loadstones* by the space of 24. houres you may alter the points of any base *loadstone*, which you would, and make them both North or South as you please: so that the *loadstone* which you would alter be but base in qualitie, and not great in substance, and that the other be of a reasonable bignes, and good strength. And this vertue by such application of two *loadstones* I haue often found effectuall in new bricke lately taken from the kill without any farther putting into the fire at all; And although it be against the nature of a *loadstone* to haue both his ends naturally of one vertue, that is to say, both of them of a North property, or both of them of a South property: yet here it is to be vnderstood, that it is the forcible violence of the strong ones, being applied iointly vnto each end of the weake, that doe chase the contrarie property of the weake one into the middle thereof: And therefore if you diuide this weak one in the middle, then both those ends, which being ioyned together were the middle, (where no *loadstone* can shew any vertue) being now disioyned,

ed, and become ends, will preſently ſhew a contrary property (according vnto *magneticall* nature) vnto the other two ends.

Chap. II.

The ambiguity of the North and South ends of Magnets and Magneticall bodies explained, and Doctor Gilbert *therein defended.*

THere is not any one errour that breedeth a greater confuſion in *magneticall* knowledge, then the miſtaking of the right vnderſtanding of the true North and South ends, aſwell in *magnets* themſelues, as alſo in *magneticall* bodies, whoſoeuer therefore that will take a little paines in the beginning for to vnderſtand this well, ſhall free himſelfe from many intricate difficulties in this argument, which otherwiſe muſt needes befall him; wherein ſome hauing limed themſelues, haue fallen into many errors, euery one ſtill begetting another worſe then himſelfe. All thoſe which did write before Doctor *Gilbert* did name that end of a *magnet* which being placed in a wooden diſh, and ſet to ſwimme in water, would turne and ſettle it ſelfe towards the North, the North end of the *magnet*; and the other the South end. And euen ſo did they of all Dial-needles, Compaſſes and *magneticall* bodies. But Doctour *Gilbert*, not for any new-fangled innouation, or ſelfe-conceit, but vpon good reaſon and firme demonſtration auoucheth and prooueth the contrarie, and clearely ſheweth, that the former vulgar aſſertion

ſeriouſly defended, tendeth vnto the ouerthrow of all *magneticall* Philoſophie, by vndermining (as it were) the whole frame thereof; and yet in common ſpeech the old rule may hold, *Loquendum cum vulgo ſentiendum cum ſapientibus.* For it would ſeeme a ſtrange ſpeech vnto a Marriner to tell him that his Flower de luce were become the South point of his compaſſe, and yet this aſſertion is moſt true, and certaine that it is the North end of euery *magnet* and *magneticall* body, that being placed in a thinne wodden diſh in water, or any *magneticall* needle vpon his pinne, which ſetteth it ſelfe and pointeth vnto the South, and it is the South end which pointeth vnto the North. For proofe hereof, take theſe wordes of North and South in whether of the two former ſignifications you pleaſe, and make triall thereof in any two *magnets*, or any two *magneticall* bodies, ſo placed that they may freely turne according vnto their natures, and you ſhall alwaies ſee a naturall inclination of the contrary ends of the one vnto the contrary ends of the other, as of the North end of the one vnto the South end of the other, and reciprocated of the South of the one to the North of the other; But the ends in the one and the other will alwaies flie from thoſe of like denomination, as the North end of the one from the North end of the other, and the South end of the one from the South end of the other.

For as much then as all *magnets* themſelues, and all *magneticall* bodies (being ſo placed as they may haue their free motion) compoſe themſelues *magnetically* towards the Poles of the earth, it muſt needs be that

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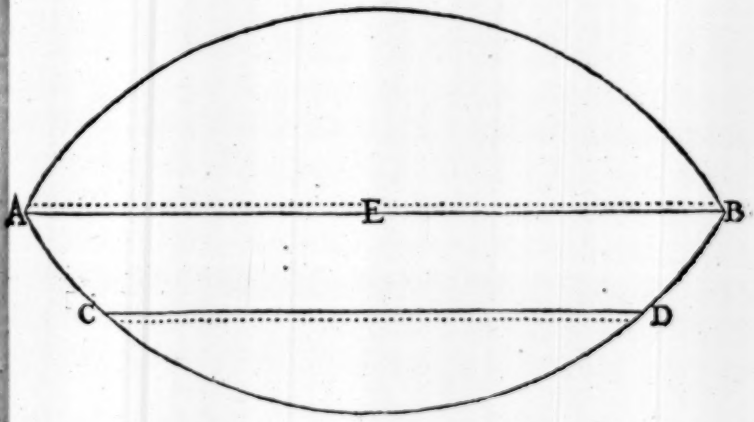
it is the true naturall South end of the *Magnet* or *Magneticall* needle, that pointeth towards the North of the Earth: and it is the true naturall North end of the *Magnet* or *Magneticall* needle that pointeth towards the South of the Earth, becauſe the contrary ends doe affect one an other, and each of them doe naturally flie, the one end of the one, from that end of the other, which is of like denomination vnto it ſelfe: for example, In this following *Diagram* of the whole *Magnet*, E. A, is ſuppoſed to note the true naturall North end thereof, and B. the South end.



This *Magnet* being placed in a woodden diſh, ſwimming in water, freely muſt, and will, of Magneticall neceſſitie, with his true North end, A. ſettle himſelf ſo, that A. muſt point towards the South of the Earth. And the South end, B. towards the North

of the Earth: Becauſe all Magnets and all Magneticall bodies, do naturally affect, the one the contrary end of the other, and doe auoide and flie from their ends of like denomination.

Now for a further conſideration of theſe properties ſuppoſe that you will cut of a peece of this *Magnet* meridionally, viz. C. D: manifeſt experience will ſhew, that C, which did in nature participate with A. in the entire *Magnet*, E: (as being both of the true North part thereof) now being ſeparated, will not abide it. In like manner D, of the other end of the little one, will not abide, B: of the great one, with whom being entire in nature he did participate, as being both true Southerly parts of the entire *Magnet*, E: And that becauſe the ends of like denomination of any two *Magnets*, doe naturally flie the one from the other.

But here you muſt beware of an errour, which ſome vnhappily haue entangled themſelues withall: who beholding the afore-mentioned diſcord (as betweene A: and C:) wrongfully ſuppoſed, that, if both theſe *Magnets* the greater and the leſſe, were conueniently placed to ſwim in water the little one would not with his end C, point vnto the South of the earth, as it did in the *Magnet* being entire; where it was a part of the true North end, but would point quite contrarily. There is no manner of any ſuch alteration, but that both the great one and the little one (and all the like, that are cut meridionally one from another) will abſolutely point the very ſame way which the entire one did, only you muſt know, that the meridian Line will ſomewhat be remoued

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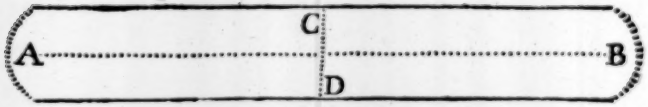
in each of them from the diuiſion, as you may geſſe by the two prieked lines, parallel vnto the meridian (or axis) A: B: of E. the entire one, and the diſagreeing of their ends is onely within the *Orbe* of their forces, both their generall diſpoſitions towards the Earth euer continuing one and the ſelfe-ſame that it was at the firſt. Yea moreouer, place them ſo that they may freely ſwim within the orbe of their owne force, and they will (with very little helpe or none at all) conforme themſelues in ſuch ſort that the one of them will ioyne it ſelfe endlong vnto the other, at their contrary ends, and point the ſame way both of them, the which they did at the firſt in the entire one. If you touch the end of any *Magneticall* needle vpon A, being the true North end of that *Magnet*, that end of the needle will become a true South end, and will point vnto the North of the *Horizon*: if you touch it vpon B, that will become a true North end, and will point vnto the South of the *Horizon*. And the like will it doe, if you touch it vpon, C: as when you touched it vpon, A, and vpon, D, as when you touched it vpon B, although in both theſe not ſo ſtrongly; ſo that *Doct: Gilberts* aſſertion doth not gaine-ſay the Marriners opinion, that his *Flower de Luce* ſhould not ſtill remaine the North point of his Compaſſe, onely hee ſheweth which end of the *Magnet* it is, which doth giue him that vertue, namely, that it is the true North end; ſo that if you hold the true North end of the *Magnet* neere vnto the *Flower de Luce* it will come vnto him: if you take away the *Magnet*, it will come vnto the North of the *Horizon*.

Horizon. If you will diuide a *Magnet* not meridionally as in the former example, but



æquinoctially, as in this by the pricked line, C: D. A. being still the true North end, and B: the true South end, and A: B: being the Meridian line, or axis of the stone: if you set these diuided seuerall peeces a sunder, that they may swim within the *Orbe* of their forces, they will affect to ioyne themselues in the very place where they were diuided, as also in the ends, A: vnto B: by the former reasons of contrary denomination. And if you place them a swimming without the *Orbe* of their forces, A: and B: will still yet retaine their former natures, and euen so will it fall out, if you make your diuision in any other place of the *Magnet* towards either end parallell vnto æquinoctiall of the *Magnet.*

Chap. III.

Certaine generall obseruations of the nature and properties of the Loadstone.

Loadstones of diuers and sundry parts of the world as of *Norway, Elva, Bengala,* &c. haue one and the selfe-same property directiue, I meane of shewing

ing the North and South, and alſo the ſelfe-ſame points reſpectiue declining or dipping vnder the *Horizon*. They doe likewiſe agree in their variations, and each one will draw yron, and likewiſe one another. Euery *Loadſtone*, of what forme ſoeuer he be, hath either actually or potentially two points, the one Northern, the other Southerne. Actually, if either by caſualty (if it ſo fall out) or by induſtry the ſtone be ſo faſhioned, that thoſe two oppoſite points be eminent or perſpicuous therein: Potentially, if that either the ſtone be flat and but thin in the dimenſion of North and South though broad otherwiſe, for ſo ſhall the vertue of the ſtone be diſperſed to the extreame parts thereof, in the edges round about; or if it haue the two oppoſite points in any concauitie, then will the ſtone ſhew in the eminent border or edge of that concauitie onely a confuſed dull force, and in the concauitie it ſelfe very little or nothing at all. That ſtone is well proportioned for touching which reſembleth an *Ouall* forme, and hath his due points in his ends, and is voide of any bunch or concauitie. For the generall forme of a ſtone being good, euery concauitie is a diminiſhing of his force, and euery bunch is but a ſuperfluous burden; Inſomuch that my ſelfe haue made experience of a ſtone that of ſubſtance was very good, and of weight was vpon a three and twenty ounces, but of a diſordered forme, I therefore tooke away twelue ounces from him, and yet diminiſhed not one iote of his force. And this did I in a ſtone that was all of like ſubſtance. But if it be one that is intermingled of diuers ſubſtances (as many ſuch there are and thoſe

eaſily diſcerned by their colour) you may ſomtimes take away three quarters and more of his ſubſtance without diminiſhing any thing at all of his vertue. For colours, moſt commonly the Iron-like is beſt: very blacke or whitiſh ſeldome proues good; gray, indifferent; the more white in any ſtone, ſo much the worſe. There are certaine that are of an yron colour, mingled with red, of which ſome bee very good, ſome but indifferent. By three waies you may proue whether a *Magnet* be good or not; the one is, by taking vp yron with the bare ſtone: The other by giuing more or leſſe vertue vnto a knife, or any ſuch thing to lift yron: The third if it will with good ſtrength moue a *Magneticall* needle a pretty good diſtance of, and readily alter the ends of the needle without touching of them, making the North South, and the South North: The two latter of theſe doe neuer faile, but the firſt doth diuers times. And very certaine it is, that whatſoeuer ſtone doth moſt ſtrongly impart his force vnto a knife, or moue a needle with quicknes, the power of lifting vp yron in ſuch a one, will mightily be increaſed with a Cap. For this is generally the nature of all *Magnets*, that if there be 2. of different quantities, and equall ſtrength in lifting vp yron, the greater will giue the ſtronger touch, and moue a *Magneticall* needle farther of, although the leſſer will take vp as much yron, or ſomewhat more, than the greater. And againe ſuppoſe there be a *Magnet* of a pound weight, that being fitly armed, will take vp foure pounds of yron, and not aboue, if you diuide him into very ſmall peeces, you ſhall finde of them being orderly vſed that will lift

vp

vp 20 times, yea 40 times his owne weight and a great deale more, if they be made very ſmall, as of three or foure graines weight; And yet where the great one will giue a touch vnto a knife for to take vp foure ounces of yron, and will moue a *Magneticall needle* three foote of; this little one will not giue a touch vnto a knife to take vp a needle, nor moue a *Magneticall needle* foure inches of; that as a *Magnet* is diminiſhed in ſubſtance (I meane a *Magnet* of a regular forme) ſo doth he looſe in his vertue of touching, and increaſeth for his ſmall quantitie in lifting of yron, whereby it is manifeſt that theſe two properties goe not alwaies ioyntly together in the ſame proportion and degree. And here hence it is, that many ſeeing little *Magnets* artificially ſet in rings for to take vp (for their quantitie) a great peece of yron, doe wrongfully imagine that the great one (whoſe particles they are) or any other great one, ſhould doe the like, namely to take vp ſo many times their owne weights. Alſo very often it is ſeene, that *Magnets* being of like forme and weight, but of diuers kinds, the one will take vp more yron of himſelfe without the capp, and yet the other giue a farre ſtronger touch; but then, if you doe fit both of them accordingly with caps, he which gaue the ſtronger touch, will take vp more yron than the other. The principall force of the *Loadſtone* well proportioned, paſſeth in a direct line, from the middle of his ſubſtance, being (as it were) a Center, through his two ends or points, which are the imaginarie lines of his chiefeſt force, from which Center, there iſſue infinite others alſo through all parts of the *Superficies* of the ſtone,

on either ſide, betweene the two extreame points and the middle, all which on either ſide of the middle, being of one nature and property in reſpect of their touch are exceedingly different in ſtrength. For that ſtill waxeth leſſe and leſſe, as it approacheth continually nearer and nearer the middle, where at length in the middle, betweene the two ends, it vtterly fainteth and commeth to nothing. The *Loadſtone* communicateth his property to the yron or ſteele that is touched with it, ſo farre forth, as the yron, or ſteele, which is touched, hath habilitie to receiue, and ſo that good skill in the touching be obſerued, ſteele is farre better than yron, and receiueth a farre ſtronger touch, and much more effectuall. The purer ſteele, ſo much the better; and if it bee yron, the purer likewiſe, the better, alwaies regarding that both of them be very ſmooth, and cleane, and haue their due temper. The principall property in common vſe is the ſhewing of *North* and *South* in the *Horizon*, with the appendants therevnto belonging, which is much more apparant, more ſtrong, and more commodious in the iron and ſteele, that is touched, than it is in the ſtone it ſelfe, becauſe the ſubſtance of them may be filed and cut away, and drawne into any forme, that we like or liſt our ſelues, which the ſubſtance of the ſtone will not permit. The *Magnet* is of ſuch nature, that euery peece broken of and ſeparated from the whole, hath all the properties of the whole, the ſame ſeuerall points of North and South, and habilitie alſo for the touch, like in kinde, though not of equall power, according to the quantitie and proportion of the peece, and the

part

part of the ſtone that it is taken from, and this propertie in a meaner ſort hath the touched needle and wyar of a Compaſſe alſo.

CHAP. IIII.

By what meanes the chiefe points of any Magnet of what forme ſoeuer may eaſily be found out.

MAke a reſpectiue or declinatorie needle, of an inch or thereabouts in length and giuing him his touch, faſten him by his *Axis* vpon a little forked ſticke, or any ſuch thing, that the needle may haue free ſcope, then offer the ſtone neere the needle, turning it round about, and immediately you ſhall ſee the North of the needle (as it is as yet commonly called, becauſe it pointeth vnto the North) point directly vnto the true North end of the ſtone as ſoon as it commeth neere vnto it, and as you turne away the end of the ſtone the needle will point ſtill ſomewhat towards it, till the South end of the ſtone approacheth, for then will the needle wheele about vpon his *Axis*, and point directly with his South, and to the true South of the ſtone. But if you hold the needle neere the ſtone, in ſuch ſort that it cannot turne about at liberty then the force of the ſtone may ſoone change the properties of the ends of the needle, that the one point which was North ſhall become South, and that the other which was South ſhall become North, yet the thing it ſelfe is eaſily diſcerned: For the Northerly end will alwaies hang lower.

And whereſoeuer the needle, being held neerer vnto the ſtone doth ſtand parrallell vnto it not inclining with either end, towards the ſtone there directly, vnder the middle of the needle, the North and South properties of the ſtone doe diuide and part themſelues. This matter is much better performed, with a ſmal narrow *loadſtone* of halfe an inch (more or leſſe) in length, hauing in the ends his due points of North and South and wrought ouer with ſilke of two colours from the midle to each end; as for example yellow and white; That part which pointeth to the North let it be wrought ouer with white, and the other with yellow. Then if you hang that in the midle by a fine ſilke thread, and apply it vnto any other *loadſtone*, the South end of the one will readily finde out the North end of the other; and contrariwiſe. In like manner, with this *magneticall* inſtrument you may ſee two pretty concluſions. The one if you touch a knife with the end of a forcible *loadſtone*, whether it be North or South, and hang this wrought one by a ſilke thread in the midle, that

it

it may hang freely, the one end will craue towardes the point of the knife, and the other will not abide it. The other is, if you hang it end-long, with the true North end right ouer the North end of a forcible *loadſtone* or with the South end ouer the South end of the other, you ſhall ſee that it will in no wiſe (being let downe) come vnto the North point of that *loadſtone*, but will (contrary to *philoſophicall* principles that heauie things ſhould tend directly downewards) by the meanes of the ſilke thread, ſwimme or wheele about the end of the *loadſtone* in the aire: yea and lift it ſelfe ſomewhat vpward, rather then perpendicularly light downe vpon it, yea this it will do although you place a plate of ſiluer, lattin, or any ſuch thing, betweene the ſtone and it ſelfe.

The ſecond way.

Thread a common ſowing needle, and touch the point of it with the North end of any *loadſtone*, then offer it vnto that ſtone whoſe points you would find out, holding the needle by the thread about an inch there-from, and in turning the ſtone about, you ſhall preſently ſee the needle point vnto the North end of this ſtone, and flie from the other end, when by your turning it commeth neere. The contrary effect enſueth, if you touch the point of the Needle with the other end of the ſtone, wherein you may behold that ancient conceiued, and of late yeeres maintained errour of the contrarietie of *Magnes* and *Theamedes* to be nothing elſe but a contrarie property of one and the ſelfe ſame *Magnes*.

The

The third way.

Breake off the point of a ſowing needle, halfe an inch long or longer (if the ſtone be good) but not aboue a quarter of an inch, (if it be a baſe ſtone) lay it vpon the ſtone, and moue it to and fro vpon the *Superficies* thereof (being ſmooth) with the needles point forwards, and as it commeth neere any of the two points of force, it will raiſe it ſelfe more and more: but being brought vnto the point it ſelfe, it will ſtand there ſtraight vpright; If the ſtone be ragged this cannot well be practiſed, otherwiſe of all other it is the moſt certaine way. Now whether it be your North or South end the effect will ſoone declare.

The fourth way.

Hauing an ordinarie Diall with a *magneticall* needle, or a ſayling compaſſe, or any *magneticall* needle ſtanding on a ſharpe pinne, hold neere thereunto the ſtone turning it in your hand, then will the north end of the needle (I meane the end that pointeth to the North) reſpect the true North point of the ſtone.

The fift way.

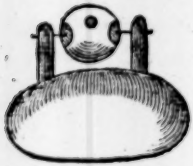
Alſo if you touch a common ſowing needle (the longer the better) and put it through a little peice of corke, not bigger then may well beare it vp, ſo that by the meanes thereof, it may ſwimme in a baſon of water, the ſame if you offer the ſtone vnto it, will

ſhew

ſhew the like effect. And here it is to be remembred, that none other way whatſoeuer will more readily or truely define the *magneticall Meridian*, then this of the needle with corcke in the water. And therefore as it is very requiſite for many purpoſes that euery Traueller either by land or eſpecially by ſea ſhould alwaies haue (if he may) an æquinoctiall Diall with him, ſo would I not wiſh that any of them ſhould be without ſome ſowing needles touched with a good ſtone which wil both ſerue the proper vſes of ſowing without impairing their touch (for it is open aire and ruſt that are the greateſt enemies thereof) And at any time with a peice of corcke, or a drie ſticke in the water will ſhew the *magneticall meridian*; a matter though meane and triuiall in ſhew, yet betweene whiles of ſo great importance that it may ſerue to ſaue very many mens liues.

A ſixth way.

Alſo if you prepare a little round *Loadſtone* of a quarter of an inch diameter or thereabout (but it muſt be a very good one) hauing his two poles marked and fitted in ſuch manner that it eaſily turne about in a little frame according vnto this picture. The like alſo in his ſort will come to paſſe, if you hang a ſmall declinatorie Needle in a frame in this manner.



Then by mouing it in his frame all ouer the ſtone, the North pole of this will finde the South of the other; And likewiſe will the South, the North of the great one; For it is not in outward ſhew between one *magnet* and another, as it is betweene a *magnet* and a *magneticall* needle, the contrarie ends of the *magnet* will couet in their motion to meete together, but the end of the needle which turneth North, will come vnto the North of the ſtone: For in very truth it is the South point of the needle, euen as the *magnet* it ſelfe being placed in a woodden diſh in water will turne with his North end vnto the South, and with his South end, diſh and all, towards the North, as it is largely declared in the ſecond Chapter of this booke. The like effect will alſo follow if you hang as aforeſaid a ſmall *magnet* in the middle by a ſmall ſilke thread, that it may freely turne without impediment according vnto his owne nature. But this property it will ſhew quicker, or ſlower according vnto the goodneſſe of the ſubſtance, and fitneſſe of the forme. The beſt forme for this purpoſe is the extended ouall, hauing his poles preciſely in his ends. If his poles be ſome pretty diſtance, the one end towards

wards the Eaſt of the ſtone, and the other aſmuch towards the Weſt, this ſtone in his length will not point vnto the *magneticall* North and South (as otherwiſe he would) but vnto ſome other point of the *Horizon*; yea following this experiment in this ſort, you may make him ſtand vnto any point of the Compaſſe: onely you ought to abridge the ſtone in his length that he may come ſomewhat neerer vnto a circuler forme, that ſo his diameter of North and South (being through the *magnetiſme* of the earth, the cauſe of this motion) may be ſo much the longer in compariſon of the Maſſe of the ſtone, and conſequently more effectuall. After the like manner you may ſo touch the wiers of a Compaſſe, that the *Flower de luce* of the flie, ſhall ſtand vnto what point of the *Horizon* you pleaſe, although the Diameter of the wiers doe ſtill remaine fixed vnder the *Flower de luce*, and the South point of the Carde.

Finally to conclude this point with a *magneticall* delight, if you touch two ſowing needles in a contrary ſort, that is, the point of the one northerly and of the other Southerly, and ſet them with their corckes the one at the one ſide of a baſon of water and the other at the other, you ſhall ſee them, as quickned with vitall ſpirit, euen ſo to moue the one end towards the other, at the firſt faire and ſoftly, but when they draw neere they will ruſh together (as it were) with a kinde of violence, the point of the one ſtriking preciſely at the point of the other, you muſt place the needle, whoſe point is touched for the North on the South ſide of of the baſon, and the other on the other ſide: Otherwiſe the heads

and not the points will runne together, a thing farre more worthy of admiration, then all the ſelfe mooners of any *Dædalus* or *Architas Tarentinus*, and more ſtrange to behold then the connexion of Iron rings combined by vertue *magneticall*, whereat S. *Auguſtine* ſo much, and that iuſtly, did wonder.

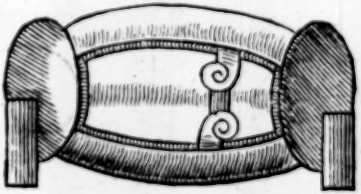
Chap. V.

The manner of capping both with ſingle and double cappes and the nature of them.

THe ſtone being brought vnto his perfect forme you muſt haue a mould made of Iron of the very ſame proportion in euery reſpect and equall in all his dimenſions, then ſetting the ſtone aſide, let your workeman frame & faſhion his cappes and fit them vpon this mould as if it were the ſtone, thus ſhall you be ſure to preſerue your *magnet* from many dangers, very incident vnto rude handling: And hauing ſo done you may ſet them on the ſtone it ſelfe, amending any ſmall faults, without endangering the ſtone, either with bruiſings, or knocks; For the thickneſſe and largeneſſe of the cappes, there can bee no generall rule preſcribed, but it muſt be left vnto the triall and ingenious dexterity of the workeman: as alſo for the handſome faſtening either by ſoadering, or riuetting of them with lattin plates to the Caps to keepe them in their places firme and ſteddy, according as you ſee in this picture of a ſtone, armed with ſingle Cappes.

The

The double Cappes are nothing but two ſquare or round knobs prominent and iſſuing out of the ſingle Cappes (as neere as may be) at right angles with the *Axis* of the ſtone, agreeable to this forme, which was faſhioned by a very skilfull workman



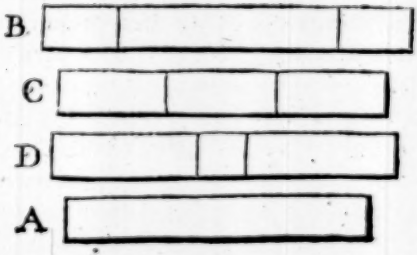
of *Wincheſter*, one that for all manner faſhioning, cutting, ſoadering, peecing, and capping of *Loadſtones*, is the moſt exquiſite that I haue knowne, as Doctor *Gilbert* would alſo confeſſe, who had his beſt faſhioned and capped by him; and ſo ſome Noblemen and diuers Gentlemen, to their great contentment, haue had the like. I finde not as yet any profitable vſe of the double capping, but only for admiration, in taking vp a greater quantitie, more by the one

halfe, then the two ſeuerall ends could doe each by it ſelfe: as if each end will take vp halfe a pound, being capped in this ſort, that each prominent end may lay hold vpon the iron fitted for it in this maner,

it ought to take vp a pound and a halfe and more: The reaſon whereof is this, becauſe the *Magnet*, in touching any one end of a fitting peece of iron or ſteele, doth not onely infuſe the vertue of that end, which toucheth the iron, into that touched end, but alſo the contrary vertue into the other end.

Now therefore in this poſition, both ends of the *Magnet* being applied vnto the two ends of the iron, theſe

theſe two contrary forces ſtriue in this peece of iron, the North to repell the South, and the South the North : ſo that each force is driuen neerer his owne end, and becommeth there ſo much the ſtronger then otherwiſe it would be. For proofe whereof, take a little narrow ſquare peece of iron, of the length of the capped ſtone, and ioyned in the middeſt with Copper after this ſort:



A. is ſuppoſed to be a long ſquare, or a ſquare-like peece of iron, in length fitting the two double caps of a *Loadſtone*.

B. a long ſquare peece, the ends iron, the middle copper. C. hath a leſſe ſpace of copper, and D. leaſt of all.

If you apply the *Loadſtone* vnto A, he will hold A very ſtrongly; but if you put any of the other three peeces vnder A, that it may touch any of them, hee will not by any meanes lift it vp. If you apply the *Loadſtone* vnto B, he will take it vp very weakly, and C ſomewhat more ſtrongly, but D ſtrongeſt of all theſe three, yet not comparable to the ſtrength where-

wherewith hee taketh vp A. Againe, although the *Loadſtone* taketh vp B but weakly, yet if you place B vpon A, he will take them both very ſtrongly; yea more, place B vpon C, theſe two vpon D, all three vpon A, apply the *Loadſtone* vnto B, being the vppermoſt, and he will lift them all vp very eaſily.

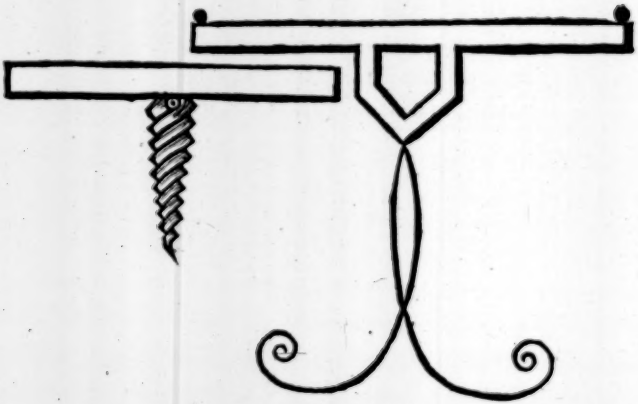
The cauſe hereof is, when a *Loadſtone* with his double cappe is placed vpon A, the force of both ends ſtriuing in that peece of iron paralel-wiſe vnto the *Axis* of the ſtone, the North and South forces are driuen more cloſely vnto their proper ends. But in B, (becauſe of the intermediate copper) there can be no ſuch cloſe driuing of his forces into their proper ends, as was in A: and therefore the *Loadſtone* lifteth vp B, but only as if his two ends were two little looſe peeces of iron, hanging in the aire, and the intermediate copper a burthen vpon them. But placing B vpon A, A in the manner (as it were) of a bridge, ioyneth the two ends together into their former combats, and the two ends of B, foraſmuch as they are but (as it were) two looſe peeces of iron hanging in the aire, the two forces of the *Loadſtone* North and South, diſtinctly and ſeuerally paſſe thorow them downwards into A, which it could not doe, if it had beene one entire peece of iron: and ſo all thoſe foure peeces, being placed one vpon another, ſo that A be vndermoſt, whether directly or ſidewiſe, the *Loadſtone* will eaſily lift them all vp, and not otherwiſe.

When a *Loadſtone* lifteth vp iron at one end onely, the vertue of the ſtone is infuſed into the whole body downward of that iron, if it be not very long.

But

But when by the meanes of the double cappes, both ends doe lift iron ioyntly together, he infuſeth very ſmall force downeward into the body of the iron that it lifteth vp: for the forces of the both ends are ſo ſtriuing in a collaterall line of the iron, paralell vnto the *Axis* of the ſtone, that whereas a good *Magnet* lifting vp at one end, will extend his vertue downewards twelue or fourteene inches, in applying both ends vnto the iron, by the meanes of the double caps, hee will not extend his force downeward the diſtance of one inch, nor with any ſtrength the diſtance of halfe an inch, as in this former example.

If a *Magnet* will lift at one end a pound of iron, faſten you halfe an ounce of iron vnto foure ounces of wood, or any other ſubſtance ſauing iron, and he will neuer take it vp, becauſe his vertue can pierce but onely that halfe ounce, and hath no power to enter into the other ſubſtance; and that ſmall portion of vertue, contained in the halfe ounce, cannot hold vp the other ſtrange ſubſtance. But this very ſame *Magnet*, by the meanes of double caps laying hold of a peece of iron fitted for the purpoſe, and of this faſhion, being but halfe an ounce, may very well and



readily take vp three pounds of any other ſubſtance whatſoeuer that is faſtened vnto it, becauſe that the whole force of the ſtone being imployed in the ſtrife of the contrary ends, in the iron paralell-wiſe, vnto the *Axis* of the ſtone, each end apprehendeth and lifteth vp this peece of iron and a great portion of any other ſubſtance that is faſtened vnto it, and his whole force being imployed herein, all his former vigour, vpward, downeward, or endlong, is as it were fettered and impriſoned, that vntill you looſe him of theſe fetters, hee is not able at either end to take vp one quarter of that which he did before.

Pliny in his naturall hiſtorie writeth, that *Dinocrates* that famous Architect builder of *Alexandria*, at *Ptolemies* commandement began to vault a Temple with *Magnets*, that there might ſeeme to hang in the aire the image of his ſiſter *Arſinoe*, made of iron

for

for that purpoſe: but both *Dinocrates* and *Ptolemie* dying in the meane ſpace, that enterpriſe ceaſed. Neither indeed (if they both had liued) could it euer haue come to paſſe by that means, by reaſon of two impoſſibilities: The one is, that by the force of the *Loadſtones*, nothing can ſo hang in the aire, but that it either muſt touch the ſtone it ſelfe, or ſome other intermediate ſubſtance betweene it and the ſtone, that barreth it from comming to the ſtone it ſelfe. For example, lay two or three needles vpon a ſmooth table, put a ſiluer or pewter plate vpon them, and vpon the plate a *Loadſtone*, then lift vp the plate aloft with the *Loadſtone* lying ſtill vpon it, and you ſhall ſee the needles hanging indeed in the aire endlong, and if you moue the ſtone about the plate, following ſtill vnderneath, but euermore touching the plate, which is the intermediate body, that keepeth them from comming to touch the ſtone, which otherwiſe by their naturall inclination very ſpeedily they would doe. But as for that image of *Arſinoe*; how had it beene poſſible for it to haue touched at once, mediately or immediately, ſo great a number of *Magnets*, whereof the pretended vault muſt needs haue conſiſted? The other is, that ſuch a multitude of *Magnets* would nothing but confound the one the others forces, ſo that one of them alone being ſolitarie and ſeuered from his company, might ſhew more force then al that inſociable ſocietie could doe, each one hindering the efficacie of the other. Much like a teeme of many horſes, where euery one drawing his ſundry way, might ſoone with diſordered ſtretching tire himſelfe and his fellowes, but neuer

moue the loade one iot from the place. Inſomuch as one (and poſſibly the worſt) would doe more good alone, where hee might orderly and freely vſe his owne ſtrength, then hee and all the many of them could doe being ioyned together in vicinitie of bodies, but extremely diſtracted through contrarietie of courſes.

The only way to performe ſuch a matter (if it were worth a doing) would be to prepare one mightie great *Loadſtone* of excellent goodneſſe: which hauing his due proportion, after an extended ouall forme, ſhould be fitted with double cappes, and ſo placed in the roofe of a building, that his *Axis* be paralell to the *Horizon*: in this ſort (out of all doubt) a faire large image might bee held vp very ſtrongly by ſuch a *Magnet*, let the ſtuffe or ſubſtance thereof be whatſoeuer, (howbeit the lighter the better) ſo that there be faſtened vnto the vppermoſt part of the Image a ſmall peece of iron accordingly prepared and placed for the two prominent ends of the double cappes of the ſtone, to lay hold thereon. But enough hereof.

In the capping of *Magnets*, this generall rule is to be obſerued, that they ought to be made of the fineſt and ſofteſt iron, and not of ſteele: the waight alſo, which the *Magnet* taketh vp, ſhould be of the like iron, and not of ſteele, as aforeſaid. For although ſteele retaineth at the leaſt ten times as much vertue as iron, when it is once ſeparated from the ſtone, can doe; yet as long as there is any contiguitie betweene the ſtone and them, hee holdeth iron more ſtrongly then ſteele. Both which differences in either of them

by

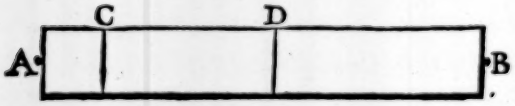
by manifeſt experience are certaine, and ſeeme to proceede of notable faſtneſſe or cloſeneſſe in the ſteele aboue the iron ; by meanes whereof the *magneticall* vertue doth longer and more forcibly continue in that then in this : euen as fire more mightily poſſeſſeth, and for a greater ſpace abideth in ſtone, or any ſuch firme or ſolid matter, then in wood, or ſtraw, or the like thinne and hollow ſubſtances : and therefore thoſe compaſſe-makers, that make the wiers of their flies for ſailing compaſſes of meere iron, ought not by any meanes to be ſuffered : for to gaine two pence in a compaſſe (and ſcarcely that) they intollerably abuſe thoſe that trauell by ſea, to their great danger and miſchiefe.

Chap. VI.

Of cementing and peecing of Loadſtones.

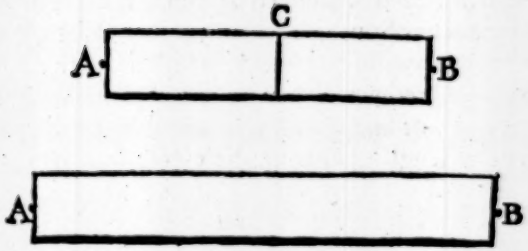
FOr your Simmon, doe thus : Take the fine powder of a *Loadſtone*, halfe ſo much powder of new bricke made very ſmall and ſubtill, one part of *Burgundie* pitch, halfe ſo much Roſſen, a ſmall portion of vnwrought waxe : mingle all theſe together very well vpon a ſoft fire, and make the whole maſſe in little roules. Now when you will cement a ſtone, doe thus : heat the two peeces of the ſtone very hot, and likewiſe the ſimmon, then ſtrake the places that you will ſoder, ouer with the ſimmon very thinly, and ioyne them ſomewhat hard together, letting them ſo ſtand vntill they be cold, and you

ſhall haue it fully as ſtrong, as if it were an entire ſtone of it ſelfe, and not to be ſeuered but by great heat of fire. In peecing of the *Loadſtones*, there muſt diligent heede be taken to the nature of the *Loadſtone* in generall, and alſo to thoſe particular peeces which you would ioyne together. The *Loadſtone* in generall (as it is ſhewed before) that his force iſſueth (as it were) from a center in the middle of the ſtone, to all the ſuperficies thereof vniuerſally, but moſt ſtrongly vnto the Poles from the middle, one way the ſtone is all of a Northerly nature, and all of it Southerly the other way. For example.

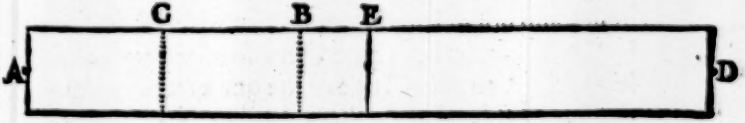


A. is the North end, B. the South end of a *Loadſtone*, D. the middle. Suppoſe you cut off a peece at C, then ſhall D. be no more the middle, but it ſhall be a part of the North of the ſtone, and the middle is remoued neerer B, and the vertue of North and South doth not now diuide it ſelfe at D (as it did before) but D. is now become a part of the North end of the ſtone, which it was not before. In this example following let there

be

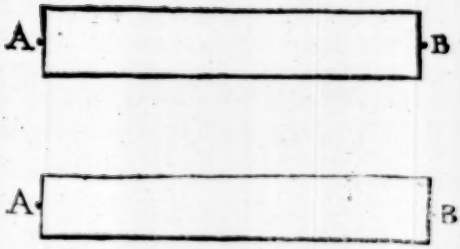


be two *Loadſtones*, the one longer then the other, the North of both noted with A, the South with B, the middle of the ſhorter, where the North and South properties doe part, is C. Suppoſe you will faſten theſe two with ſimmon, the end B. of the ſhorter vnto the end A. of the longer, ſo ſhall theſe two become one *Loadſtone*, and not onely C, which was the middle (where

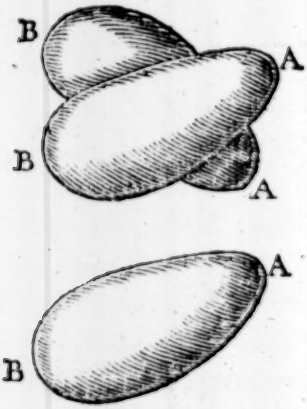


the North and South properties did part) in the little one, is now become a part of the North end in this conioyned *Loadſtone*, but alſo euen B. it ſelfe, which was in the ſhort one the very South Pole, is now in this become part of the North portion, the middle of this (where the North and South properties

ties doe part) being in E, and theſe two *Magnets*, which had each of them two points, the one North and the other South, being ioyned together, haue but only two points in all, the one North, the other South. Moreouer, if you haue two *Loadſtones* (for example) of like goodneſſe, about foure inches a peece in length, hauing their North and South points duly at their ends, if you cut off at either of their ends halfe an inch, and conioyne them with the contrary of the great ones, they will preſently haue contrary properties vnto that which they had before; ſo that a needle touched before that would turne North, being now touched in the ſelfe ſame place will turne South, ſhewing that the vertue of the two ends doth alwayes proceed and extend it ſelfe from the body of the whole *Loadſtone*, and from the whole, ſheweth it ſelfe moſt forcible (as aforeſaid) in the ends; and either of the *Loadſtones* will be in his perfect goodneſſe, as at the firſt. If you thinke good to ſet two *Loadſtones* together in ſuch ſort, that you would haue the augmentation onely in thickneſſe, and not in length, then doe thus: If they be both of one length, grinde them ſo that they may ioyne cloſe, the broad ſide of the one agreeing with the broad ſide of the other, hauing North vpon North, and South vpon South, as in this example.



A. muſt be ioyned vpon A, and B. vpon B : but if you ioyne the two ſo, that A. lighteth vpon B, you marre the new *Magnet*, by confounding his forces. Notwithſtanding if you like to ioyne them in length onely, not in thickneſſe, then indeed muſt you combine B. and A, and not A. and A, nor B. and B, leſt here alſo you incurre the former inconuenience, of confuſion of forces. Take another example : Suppoſe a *Loadſtone* to bee long and ſomewhat round, ſmaller at one end then at the other, the ſmaller end to be North ſigned with A, the other South ſigned with B : let this *Magnet* bee diuided long-wayes into two equall parts, thorow both the Poles, A. and B.



And let one of theſe halfes be placed vpon a peece of glaſſe or a ſmooth Table; certaine it is, that if you do offer to touch A, of this, with A, of the other, this A will turne away from that, which (the ſtone being entire) it did ioyne with before: Or if you offer B, vnto B, it will doe the like. And no maruaile, for in this caſe of touching A, with A, or B, with B: what elſe in effect doe you, but attempt to ioyne the two halfes in length and that at like ends? A thing directly repugnant to the principles of *Magneticall Philoſophie*. But let me admoniſh you, to put the rounder ſide of the ſtone downewards, next vnto the glaſſe, that it may turne the quicker: yet if the ſtone be excellent it will doe the ſame alſo vpon the flat ſide. Moreouer if you place this two halfes, the one vpon the other preciſely as they were at the firſt, they will

agree

agree very well: becauſe they are as one, and the ſelfe-ſame *Magnet*. But if you place them the one ſwaruing from the other, at either end, then will A, of the one, turne about vnto B, of the other; becauſe they are now as two ſeuerall and diuers *Magnets*. For the better conceiuing hereof, you are to remember, that euery part of a *Loadſtone* (be it an half or any other) being once diuided from the whole, is (as Schoole-men call it) *Totum integrale*, a whole *Loadſtone* by it ſelfe, vtterly diuerſe and eſtranged from that whole, whoſe part before it was, and therefore reteineth diſtinctly in it ſelfe, all the properties of a *Loadſtone*, though not ſo ſtrong, as the whole had when this was ioyned therevnto.

In *Loadſtones* there is a part truely ſaid to be diuided from the whole, when the points of that part, or ends, or *Poles* (and ſo, by neceſſary conſequence, the *Axis* and *Æquator*, in which the vniuerſall frame of *Magneticall* power conſiſteth, haue a poſition diuers from the *Poles* or points of the whole. For this cauſe, in the laſt example the one halfe A: B: being ſuppoſed to ſwarue from the other halfe B: A: at either end, muſt needs preſently be diuided from it, and now cannot be *pars integri*, but is of neceſſitie *Totum integrale*, a ſeuerall and abſolute *Magnet* of it ſelfe, and ſo by an eſſentiall property common to all *Magnets*, couereth with his point A, the contrary B: of that which is vnder it. Wherefore like as exact agreement is betweene two *Mathematicall* figures when being applied together, the extreames of the one, doe preciſely fall vpon the extreames of the other, each vpon his correſpondent extreame, and

is made one therewith: euen ſuch is the perfect compoſition or ſetting together of the parts of a *Magneticall* body, and namely of thoſe two equall parts before exemplified, you muſt ſo ioyne one vpon another, that the two extreames, or ends, be alwaies of the ſame nature Northerly, or Southerly, in both parts: And that by due application of the parts, the two Northerly ends be vnited, and become one, as alſo the two Southerly ends after the ſame manner. But if theſe parts, being of equall length be ioyned longwiſe, the North of the one, vnto the South of the other; thoſe two ends that were (being now no ends but the iuſt middle of one *Magnet*) haue loſt their properties which they had, when they were ends. For thoſe properties, by this vnition, are aboliſhed: but their other ends ſtill reſerue their former and ſtronger vertues of North and South: And ſo, according vnto *Magneticall* nature, one *Magnet* ſhall haue but two *Poles*, the one North, the other South. Againe, if you will peece two *Loadſtones* together in thicknes, the one of thē being longer, than the other; then you muſt either cut the longer, that it may be fit in length, vnto the ſhorter; or elſe peece the ſhorter in ſuch ſort as is afore deſcribed that he be equall in length to the longer, & what ſoeuer diſorderly parts perhaps ſhall bee in any of them, they may, euen after they are cemented, very well be ground away. Alſo if there bee holes or dents, with little peeces of *Loadſtones* cemented (their points being obſerued) they may be filled vp, without any manner of dammage or deformitie, no more than there had not been any ſuch at all. And

after

after this method you may (with labour and induſtry) of many *Magnets*, make one as huge, and of what forme you pleaſe. And although the *Magnets* of this body, magnetically compact (as I haue here ſhewed) were neuer ſo many in number, yet the whole will haue but two principall points, the one North, the other South, euen as if it were one naturall *Loadſtone*: and all of them will contribute their forces, vnto thoſe two points; So that if there were twenty of them, being after this order cemented together into one body, the whole would haue but two points, but if you will place them in a vault, according to a *Maſons* trade they will haue 40 points, twenty North, and as many South, and will worke the like effect in drawing yron, as (to vſe the former groſſe ſimilitude) if a teeme of horſes were ſet in their traces contrary the one to the other, the one to pull one way, the other another. As for the Turkes *Mahomet*, hanging in the ayer with his yron cheſt it is a moſt groſſe vntruth, and vtterly impoſſible is it for any thing ſo to hange in the ayer by any *Magneticall* power, but that either it muſt touch the ſtone it ſelfe, or elſe ſome intermediate body, that hindreth it from comming to the ſtone (like as before I haue ſhewed) or elſe ſome ſtay below to keepe it from aſcending, as ſome ſmall wier that may ſcantly bee ſeene or perceiued.

Chap. VII.

Of the variation of the Magneticall Needle with the Appurtenances thereunto belonging.

THE variation of the Magneticall Needle, being aptly fitted and placed vpon his pinne, is nothing else, but the swaruing of the pointing thereof in the *Horizon*, from the meridian line there, the portion of the *Horizon* intercepted betweene the true Meridian line and this pointing, sheweth of what quantitie the variation is, and giueth it his name, to wit, which way it lyeth, either Easterly, or Westerly, and it is obserued by either end of the needle as you please.

In times past men obserued onely by the North end of the needle, because they vnderstood not that the *Loadstone* hath a South vertue, as well as a North; And therefore did touch their needles and wyars of their compasses alwaies for the North onely, leauing those ends of the wyars bare, that they might be refreshed with a new touch at any time afterwards: but the other ends they couered, not knowing that they were also apt to receiue as forcible a vertue from the *Loadstone* for the South, as the other for the North. For the right vnderstanding of the variation, with his necessary dependants, wee must vse the meanes of two circles: The one of them I will call the *Magneticall Almicanter*; The other is already knowne by the name of the *Magneticall Meridian*.

This *Magneticall Almicanter* is a circle paralell vnto the

the *Horizon*, whoſe center is the verticall point, and is deſcribed by the diſtance betweene the verticall point, and the neerer *Pole* of the earth. The true *Magneticall Pole* is the *pole* of the earth; The *magneticall* reſpectiue Pole, or (which is all one) the Pole of the *Magneticall Meridian*, is a point in the *Magneticall almicanter*, diſtant Eaſterly or Weſterly from the true pole as many degrees in that *almicanter*, as the variation of that place containeth in the *Horizon*, but alwaies it is in the contrary part of the true *Meridian*, that is, if the variation of the South point of the needle be Eaſterly the reſpectiue pole is Weſterly: but if you obſerue with the North end of the needle, the reſpectiue pole and the variation are both one way in all our Northerne Climates. If the variation of the South point of the needle bee Weſterly, then is the reſpectiue pole ſo many degrees in the ſaid *almicanter* Eaſterly, and therefore alwaies of the ſame height with the true pole aboue the *Horizon*. For ſince all great Circles of the globe doe neceſſarily cut one another in two points into two equall parts: theſe two therefore muſt needes doe euen ſo in the *Zenith* and *Nadir*, by their very definitions; So that theſe two points (the *Zenith* and *Nadir*) are alwaies alike common vnto them both, aſwell vnto the true, as vnto the *Magneticall Meridian*.

Where-hence it followeth neceſſarily, that alwaies the one halfe of the *magneticall meridian* is on the Eaſt-ſide, and the other on the Weſt ſide of the true *meridian*, the common *Zenith* and *Nadir* euermore keeping their equall diſtances from the Poles

of

of the one of them, as they doe from the other. For example: Suppoſe the common *Zenith* to be in the *Æquator*, you ſayling East or West, as long as there is no variation, there is no *magneticall meridian*, there are no *magneticall Poles*, but thoſe of the world. But as ſoone as, ſayling ſtill vnder the line you doe finde a variation it is the *magneticall meridian*, that by his ſwaruing from the true *meridian* of the world in the *Horizon* ſheweth the quantity of the variation, and giueth it alſo the denomination of Eaſterly or Weſterly, and his *axis* is the line of variation. But ſuppoſing the common *Zenith*, to be in any paralel, betweene the *Æquator* and the *Pole*, then is it not the *axis*, but ſome other *Diameter* of the *magneticall meridian*, which ſheweth the variation in the *Horizon*; And the *magneticall meridian* euermore cutteth iuſt ſo many degrees of the *magneticall almicanter* on the one ſide of the true *meridian*, as the ſame *Magneticall Pole* is diſtant in the ſame *almicanter*, on the other ſide of the true *Meridian* from the *Pole* of the World. And this is to be vnderſtood in correſpondent manner, as well of the South *Hemiſphere*, as of the North.

The reſpectiue *Magneticall meridian* (where any variation is) is a circle that paſſeth by the verticall point and the Nadir, and both the reſpectiue *Poles*, croſſing the *Horizon* at right angles in the points of variation, of which circle the line of variation is a *Diameter*, but where there is no variation the true and *Magneticall meridian* are both one & the ſelfe ſame, and ſo in like manner are their *Diameters*. Thoſe circles and poles are tearmed reſpectiue becauſe that in euery

euery place where any variation is, the *Magneticall* needle doth reſpect them, as well in the property of direction, as in that of declination, or inclination. For thus alſo very well it may bee tearmed. By the property of direction, I doe meane, with Doctour *Gilbert*, the *Horizontall* motion of the *Magneticall* needle: By the declination, or inclination, I meane the deſcending, and (as it were) the ſinking motion of the neede vnder the *Horizon*, in his proper *Azimuth*, or *Magneticall meridian*; But if there be no variation, the needle alwaies pointeth vnto the true *Meridian* of the earth, and towards the Poles therof, in both thoſe properties. The true Poles of the earth (which are thoſe two points equally diſtant from each part of the *Æquinoctiall* of the earth are alwaies the ſelfe ſame. The reſpectiue *Poles* alter with euery *Horizon*, where there is any variation, but neuer out of the aforenamed *almicanter* of that place. The cauſes of the differences of the reſpectiue *Poles* and *Meridians* from the true *Poles* and *meridians*, and ſo of all variations, are onely two; The chiefe and moſt generall is the vaſteneſſe of the Ocean ſea, by moiſtneſſe whereof the *Magneticall* collaterall force of ſo much earth as it couereth, is much hindered and dulled. And by that meanes the next great Continent hath more power ouer the correſpondent end of the *Magneticall* needle, then otherwiſe it could haue if all were alike one entire Continent: and therefore cauſeth the directiue property of the needle ſomewhat to ſwarue towards that way, which is that, which we call variation; but yet the vaſteneſſe of the Ocean doth not hinder the decli-

nation of the *Magneticall* needle ; Becauſe his hangings conſiſteth but in length and breadth, and not in depth. For although in compariſon of a pond or riuer, the ſea is ſaid to be of a wonderfull depth, yet if this depth be compared with a *Semidiameter* of the earth, it beareth a very exceeding ſmall proportion, nothing at all to hinder the mightie *magneticall* declinatory force of the whole earth ; For the greateſt depth that euer any man of skill eſteemed it at, was not aboue two Engliſh mile, at the vttermoſt, when as daily experience maketh it manifeſt, that a great Continent wil ſhew his *Magneticall* collaterall force, by cauſing a variation, aboue two hundred miles of from the place, and therefore Doctor *Gilberts* feare in that point I take to be needleſſe, ſuppoſing a variation of declination. The ſecond cauſe of variation, is any great mountainous region not farre of, when a man is in ſome great *Latitude* towards either of the *Poles* : if that mountainous region lie Eaſterly or Weſterly from you, it will cauſe the needle ſomewhat to ſwarue that way. But variations of this ſort are of ſmall continuance, and in ſayling ſubiect vnto ſudaine alterations, yea many times quite contrary from Weſterly to Eaſterly & afterwards backe againe within ſhort ſpace : as our firſt famous Pilote *Steuen Burrough* found by his experience in the diſcouery of the *Scythian* ſea-coaſt between the north Cape of *Finmarke* and *Vaygates*. The reaſon whereof ought heedfully to be regarded which is that the *Magneticall force* of the whole earth, doth (as in all *Magnets*) ſhew it ſelfe moſt ſtrongely in the two *Poles* thereof, and in thoſe places which are neere vn-

to

to them: but alwayes it muſt be remembred, that all the force they haue doth iſſue out of the whole terreſtriall body, as it doth likewiſe in all *Magnets* out of the body of the *Magnet*: and therefore in any part of the ſuperficies of the whole terreſtriall body, it is impoſſible that any variation be aboue 90. degrees, becauſe the vertue of the whole can neuer bee ouerſwaied by the imperfection of a part, and eſpecially of ſo ſmall a part as any one portion of the Ocean is in his very ſuperficies, in reſpect of the body of the whole earth: yea I am thorowly perſwaded, that there neuer was nor euer will bee any variation, by any good obſeruation found for to bee ſo much as ninety; neither any ſhew of ſo great variation any where, except it bee very neere vnto either of the Poles, where there is ſmall credit to be giuen to the obſeruing of any variation: for the variation being (as aforeſaid) the difference of the pointing of the *magneticall Needle* in the Horizon from the true Meridian, foraſmuch as in places neere the Pole, there is no manner of certaintie of either of theſe, it is not poſſible to finde the variation, if there be any. The reaſon whereof is this, no man may trauell thoſe Seas, but whiles the Sunne abideth on that ſide of the Æquator, whereby they haue continuall day, and by that meanes are ſecluded from any helpe of the ſtarres, neither if they might bee ſeene, would they bring any great helpe. For the difference of heighth in many houres is ſo ſmall, that by a very large inſtrument a diligent obſeruer with great paines will hardly finde the Meridian Line, all the Meridians themſelues comming

ſo neere one to another, and meeting in the Pole, and their Horizon being in a manner paralell vnto the Æquinoctiall. And as for the horizontall *magneticall Needles*, to ſhew their pointing in the Horizon as they were wont to doe, they comming into this climate may ſay, *Fuimus Troes*. Their direction is as it were giddy and vncertaine, and when their center commeth vnto the Pole it ſelfe, it is quite vaniſhed away; for from thence all the points of the Horizon are onely South, if it be at the North Pole, and North from the South Pole, and therefore in that place the inſtrument of declination is farre more ſure then the Horizontall Compaſſe. And as in the Poles themſelues there is no direction at all, ſo of neceſſitie neere vnto them it muſt bee a very confuſed direction. Thoſe two places, that are called the Poles, haue no ſtrength of themſelues (as aforeſaid) but as it is contributed vnto them of the whole. As in a *Magnet*, if you breake off a peece of the contrary end, the end that is left will bee according vnto that proportion diminiſhed in his ſtrength, and the polar peece, that was broken off (be it neuer ſo little) will haue two poles as well as the great: ſo that the two parts will haue foure Poles, two of them North, and two South. Put this little peece that was broken off, in his place againe, and then each peece will loſe one of his Poles in the ſame very inſtant, and the whole will haue but two Poles, the one North, the other South, as at the firſt. Againe, if you cut off a peece of one ſide of a *Loadſtone*, that is brought into a round or an ovall forme, hauing his Poles marked in their due places

at

at each end, preſently both ends will be abridged of part of the force they had, and the Poles themſelues will be remoued vnto the other ſide, from the places that were marked, and thoſe markes will ſtand but for idle ciphers in compariſon of that they were before. Againe, take a *Magnet* of a round or an extended ouall forme, (I doe ſtill exemplifie in theſe, becauſe they are of all others, as I haue often admoniſhed, for all *magneticall* proofes the moſt excellent formes) and ſet markes on the two Poles, take a fine needle, or any ſtraight ſmall wier, and ſet it on the æquinoctiall, (I meane thereby the middle betweene the two ends of the ſtone) then will it point directly towards each Pole, if the ſtone bee ſound without any flawes, or any other groſſe ſubſtance (as may bee) intermingled with it: and if you thruſt this needle towards either end, according vnto his owne direction he will trace you a circle right ouer both of theſe marked Poles, which is the true Meridian of the ſtone. But if this ſtone hath in either of the ſides any imperfection, when the needle commeth vnto the edge or brinke thereof, it will ſwarue ſomewhat towards the ſounder ſide, and will point to neither of the true Poles. And if a circle bee drawne according to his pointing, as hee ſtandeth ſtill in that place, this ſhall be a reſpectiue Meridian of that ſtone, proper vnto that place: and the Poles. the reſpectiue Poles, differing from the true Meridian of the ſtone and his Poles. Now if you thruſt the needle further towards the end, vpon the brinke of this imperfection, it will not point (as before) but either further off, or neerer towards the true Poles,

and will giue his direction for a new reſpectiue Meridian; and new reſpectiue Poles, And in ſuch manner infinitely, if you place the needle in the middle of this imperfection, equally diſtant from the ſound parts, then will it indeede poynt towards the true Poles of the ſtone, And the Conſequence heereof is the maine reaſon, that towards the midſt of the Ocean; and likewiſe of any great continent there is no variation. Thus may you eſpecially in a round *Loadſtone* (as in a liuely example) ſee the true cauſes of all the variations that are in the whole world, reckoning as much ſpace as the Ocean couereth, to bee ſome imperfection in the body of the whole, in reſpect of the Horizontall motion of the Compaſſe. For the euidence of the truth heereof, let a man examine generally the variations of our moſt expert Nauigators (Although by reaſon of their diuerſities of the ſets of their Compaſſes, and vnfitneſſe and vnapt handling of their inſtruments, they very ſeldome times agree among themſelues) obſerued in the Atlanticke Ocean, from the Æquator vnto the parts of *Norway*, all along the Eaſt coaſt from the Meridian of the Azores: And in like manner from the Æquator to the parts of New-found-land and vpwards, all along the Weſterne Coaſt from the Azores, as farre North, as heereunto hath beene diſcouered, and he ſhall finde the ordinary practiſe to teſtifie the truth heereof, as alſo after the ſame ſort from the Æquator Southward vnto the ſtraights of *Magellan*, and all along the backeſide of *America* in the South Sea: and on the Eaſt Coaſt vnto the Cape of *Bona ſperanza*, and he ſhall perceiue the like agreement: But in

ſailing

ſailing from the Cape of *Bona ſperanza*, farther Eaſtward, that ſometime they doe finde it otherwiſe, the cauſe is the different manner of the ſcituation of the South, as yet vndiſcouered Continent. And wheras in the middeſt of the Atlanticke Ocean, about 30. leagues Weſtwards from the *Azores*, they find no variation at all, no maruell thereof: For it is about the middle diſtance betweene the two great Continents of *America* and ours.

Wherefore the round *Loadſtone* is ſignificantly termed by *Doct. Gilbert Terrella*, that is, a little, or rather a very little Earth: For it repreſenteth in an exceeding ſmall modell (as it were) the admirable properties magneticall of the huge Globe of the earth. Heerein alſo wee may beholde the reaſon why, the magneticall needle varieth leaſt in the Æquinoctiall, and moſt towards the Pole, and in the Poles themſelues giueth no direction at all: For proofe heereof, take a needle and place it vpon the Æquinoctial of the ſtone, there you ſhal ſee him ſtand equally ballanced and very ſtrongly, ſo that if you turne him from his direction, as ſoon as you let him goe, hee will preſently turne vnto it againe. The reaſon is, becauſe each Pole doth equally ſtrengthen his correſpondent end of the needle. Mooue this needle toward either of the Poles, then doth the neerer Pole ſtrengthen his end of the needle; but the farther (becauſe of the diſtance) cannot doe the like vnto his, but very weakly, and this needle will not ſtand any more equally ballanced (as it did in the Æquinoctiall) but that end next the Pole will couch downe, and the other will riſe vp. For on the North

ſide

ſide of the Æquator, the true South end is predominant, and on the other the North end hath the maſtery. And that this is alſo in the earth it ſelfe, all our late Trauellers confirme vnto vs by their daily experience, and all the very Artizans and needle-diall-makers in the world muſt needes be daily witneſſes of it. As for example: Let any workman in our Climate make a needle for a diall, when he hath fitted it and placed it on the pinne, that it may ſtand thereon equally ballanced and paralell to the *Horizon* touch it with the Magnet, then preſently that which pointeth towards the North will hang downe (yea, although you touch onely with the South end) and will not ſtand, as before the touch equally ballanced and paralell to the *Horizon*: except you cut or file ſomewhat from that end, that hangeth downe; or elſe adde a peece of waxe or ſome other thing vnto the other end of the needle to counterpoiſe it, and make it ſtand equidiſtant as it did at the firſt ſetting on: and this is a thing very certaine, that this Northerly deſcent of the needle, will be more or leſſe in all places of Northerly Latitude: In the greater Latitude the more, and in the leſſer Latitude the leſſe. But if any traueller carry this needle beyond the Æquator in the like Latitude Southerly, that end which tendeth downewards in the Northerly, will riſe vp in the Southerly, and the other ſincke downe, euen as much: and the neerer you trauaile towards either Pole, the more, that end which pointeth towards the Pole, will tend downewards: This is moſt certaine in euery Diall-needle: but a great deale more apparant it is in a long one,

then

then it is in a ſhort one. Wee cannot find that the property of direction by the Magnetical needle hath beene vulgarly practized (for ſailing) much aboue 200. yeeres. And as for the property of declination vnder the Horizon, thereby to ſhew the Latitude by the Inſtrument thereunto belonging, it is as yet a very new-come gueſt into the world, borne and bred with vs in England, and (except it bee in exceeding few mens hands) not yet in vſe, much leſſe come vnto his perfection. But this it not to be marvelled at: becauſe it is ſcantly ſixteene yeeres olde; neither is it to bee wondred if any Criticall fellowes doe contemne and deride it. Foraſmuch as either their want of knowledge, or of patience, will not giue them leaue truely to conſider of it. But what Nauigator, or rather Nugator ſoeuer contemneth it, ſhall bee ſure to repent it if euer hee come to his right wits to conſider what it is that he hath contemned. And although the needles for direction and declination doe differ much in their ſhapes, each from other; yet the properties are both one and the ſelfe ſame. For the needles for direction doe decline (as aforeſayd) as farre as the vnfitneſſe of their forme and placing will permit them: and the declining needle will not worke, but onely in his Magneticall Meridian, which himſelfe will finde out, if you turne the Inſtrument about, vntill the needle ſhew his leaſt declination vnder the Horizon, and there doe play vp and downe, & ſtop in the end in the ſame place again. But if you would haue a needle fitted to ſhew both properties, doe thus, cauſe a needle to bee made about ſixe inches long, euen and ſmooth, ſauing that

he muſt be a little bigger in the middle, then inſteed of an *Axis* (which declinatory needles haue) let him haue a ſmall hole drilled preciſely in the middeſt, and this hole being very ſmall, let it bee ſomewhat wider outwards on each ſide then in the middeſt, (which our workmen call *ſmckboared*) where it muſt bee left very ſharpe, euen almoſt as the edge of a knife: put through this hole a ſmall verginall lattine wiar, and fit the needle ſo that it hang preciſely euen vpon this wiar, inſteed of an Axletree: then touch him with the Loadſtone, and you ſhall preſently ſee the end that ſhould point towards the North, decline or bend downe to his due place of declination, if he be placed in the Magneticall Meridian; ſet a little peece of waxe or any other thing vpon the contrary part for a counterpoyſe that the needle may ſtand paralell with the Horizon, then if it ſtand at right angles with that verginall wiar, it is certainly in the Magneticall Meridian: otherwiſe it will neuer ſtand at right angles, but will make his ſharper angle alwayes towards the Magneticall Meridian. So that hanging in this counterpoiſe if you turne about the wiar vntill the needle doe make right Angles with it, then doth the needle by his directiue vertue poynt vnto the *Magneticall Meridian* line. Take off the counterpoiſe, then it ſheweth the declination for that place, and by conſequent the Latitude, if you in that manner place him in the Inſtrument of declination; ſo that one and the ſelfe ſame needle in the ſame place onely, by taking off, and putting on a little peece of wax, ſheweth plainely both thoſe properties of directions and declinations, as in like manner

ner euery inclinatory needle will doe, if the poynts of his Axis be ſharpe, and held in his boxe paralell vnto the Horizon, he will ſhew both thoſe properties of direction and declination: A fine peece of corcke or leather, or any tough ſubſtance may ſerue this needle for a counterpoyſe in all Latitudes by thruſting it towards the center in leſſe Latitudes, and towards the end in the greater, and I thinke it not impoſſible, but that a skilfull Geometrician may ſo graduate the one halfe of ſuch a needle, that it alone with his counterpoyſe, may bee a meanes to giue a probable coniecture for the Latitude of any place whatſoeuer.

CHAP. VIII.

A diſcouery of errours committed in making and touching Magneticall Needles and Wyars of ſayling Compaſſes, with an aduiſe for the true and right making and touching of them.

FIrſt the wyars that are commonly made both with vs, and in forraine countries, are of ſo baſe and droſſie iron, not apt nor ſufficient to receiue the tenth part of the vertue that fine ſteele wyar could doe.

Secondly, the ends of the wiars bee for the moſt part not filed ſmooth nor fitted euen together vpon the *Axis* of the flie; By meanes whereof the touch of the ſtone is more dully receiued, and the ſtanding

of the flie, the more vncertain, the magneticall force not being in the true axis thereof.

Thirdly, their manner of touching the wiars is altogether pittifull and ridiculous. For with a Magnet hauing a point (for ſeldome times they haue a ſtone ſo well faſhioned, that both poynts are eminent) that toucheth to the North (And ſuch an one, though hee bee but weake is preferred among them before another, thogh much ſtronger that toucheth to the South) they rub to and fro thoſe ends of the wiars, which they would haue ſtand Northerly. Wherein what doe they elſe, but play (as it were) faſt and looſe, not conſidering (as the truth is indeed) that euery touch from the ends of the wairs towards the Center of the flie with-draweth backe-again that force, which the contrary touch did giue them, and therefore ſeldome giue they aboue one quarter of that ſtrength, and ſomtimes not ſo much, which otherwiſe with the very ſame ſtone they might doe, if they ordered all things as they ſhould: yea, I am infallibly aſſured (for I haue had certaine experience of it) that with the ſelfe ſame ſtone, you may giue fully as much, and rather more force, touching in ſuch ſort, as immediately ſhall bee declared on the vpper face of the flie: ouer againſt the wiars (the card being betweene) then they doe by touching the very end of the wiars themſelues after their wonted faſhion: whenſoeuer therefore a needle is to be touched, beſides the goodneſſe and quantity, you muſt haue a regard to the forme of your ſtone, namely, whether it hath both the North and South points eminent and forcible, or onely the one. For if it hath both

both, beginne your touching neere vnto the middle preſſing the true North point, before ſpecified of the ſtone all along from thence, vnto the North pointing end of the needle; iterating thoſe touches foure or fiue times, alwayes making ſome ſtay with the ſtone at the end of the needle. The like alſo muſt you doe from the middle with the other end of the ſtone vnto the other end of the needle. But if the ſtone haue but one forcible point, then if it bee the true North, begin your touching at the South pointing end of the needle, preſſing it all along to the North, end, itterating this foure or fiue trmes, and then once or twiſe onely from the middle vnto that end, If the ſtone hath but the South point, touch the needle accordingly from the other end; For euen as the vertue of the ſtone it ſelfe is a *Semidiameter* (hauing his beginnning (as before is mentioned) in the center of the ſtone, euen ſo the force which he imparteth vnto the needle, is in the nature of a *Semidiameter* from the middle of the needle. Inſomuch that a needle being touched from the middle, but to one end with the North of a ſtone, it doth not onely cauſe that end to turne North, but it tranſmitteth alſo a contrary force from the middle into the other end of the needle, ſo that the ſtone be good, and the needle but of a reaſonable conuenient ſize, as you may euidently trie in euery knife of ordinary goodneſſe and length. But a plate of ſteele made at both ends alike, according vnto the forme heere aboue deſcribed, is much better to ſhew this effect. For when the blade of a knife is of fine mettall, the haft being of courſe iron, and alſo of a diuers forme and temper, it is not any

way capable of the like force as the blade is, which is the reaſon that if you touch the blade of an iron-hafted knife from the haft vnto the poynt with a Magnet, it will at the poynt take vp his competent waight, touch it backe againe vnto the vttermoſt end of the haft it wil take vp little or nothing: Try the like with ſuch a plate or ſteele, and you ſhall finde it take vp fully as much at the one end as it did at the other: but if you will bring his touch vnto the middle, it will take vp little or nothing at any end, and nothing at all in the middle it ſelfe:

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The reason heereof is this, the Magnet giueth his force *(Secundum mensuram recipientis)* according to the capacity of that which receiueth it, and that euermore after his owne nature, which is to haue his force strong in his ends, and none at all in the middle, if you touch the blade from the middle, with either end of the stone, the other end of the haft will immediate receiue and shew the contrary quality: euen so also will it come to passe, if you make proofe with any Magneticall needle, although that his force will bee faint and weake in comparison of the other. And in your touching you must obserue, that in pressing with the stone from the middle of the needle vnto the end, as you bring your hand backward to iterate the touch, you must lift your hand somewhat high, and not bring it backeward, close to the needle. For that would diminish the strength of the touch. But if that end of the needle be also touched with the other end of the stone, in manner as aboue I haue rehearsed, then shall hee at each end be a great deale the more strong, and the contrary fainter forces shall recoile and settle in the middle of the needle, where they can nothing at all disturbe the motion thereof.

CHAP.

Chap. IX.

Of the touching with a Laadſtone capped and without the cappe.

BY capping, is meant the placing of two peeces of iron handſomely fitted and faſtened vpon the two points of the ſtone, for iron for this purpoſe is better then ſteele. And likewiſe concerning the the waight that is to bee lifted vp, it is better to bee made of ſoft iron then of ſteele, and the ſtone will lift more therof, as long as there is contiguity: but if if the iron and ſteele be ſeparated from the contiguity of the ſtone, the ſteele will alwayes carry at the leaſt tenne times more vertue then the iron, as is before mentioned. Now whether it were beſt to touch the wiers with a Magnet being thus capped, or with the bare ſtone it ſelfe, ſome there be that make a queſtion. I haue beene tolde by one of great skill and practiſe, that he found by experience, the Compaſſe touched with a capped ſtone, not to receiue his force ſo well, as the other, and the party comming vnto me, when he was to vndertake a long voyage, to haue his compaſſe touched, requeſted mee in any wiſe to doe it with the bare ſtone: But yet I thinke it were good, that this bee confirmed by more then one mans experience, before it be beleeued, becauſe by ſome error he might poſſibly miſtake the matter. Sure I am that the capped ſtone giueth ſomewhat more vertue in his touch, and by all experience that I haue made, I finde it to continue as firmely and as long.

long. Howbeit I referre mee heerein to the triall of others alſo. A man may therefore touch the wiars firſt with the bare ſtone, & then with the ſame being capped, or contrariwiſe to bee ſurer of the greater force, and yet if any ſhall imagine the difference of the ſtrength of the touch, to be according to the taking vp of iron with the cap or without it, he is very greatly deceiued. For I haue often tried them both, but neuer could ſee the touching ſtrength in the needle to be increaſed halfe a quarter more with the cap then without it; whereas I haue alwayes (eſpecially if the ſtone were very good) found that the ſtone wil lift at the leaſt ten times as much iron: yea, a great deale more, (and ſometimes twenty times) with the cap (if it be artificially fitted) then he is able to doe without it.

Some, who would ſeeme to be of great skill, haue imagined, that the beſt way to adde ſtrength to a needle, is with a hammer to giue ſome forcible ſtrokes to one point of the ſtone, thereby cauſing litragges (as it were) or beard, to hang downe from it, & that the needle in his touching, taking ſome part of that with him, ſhould haue the ſtronger touch. But they that ſo ſuppoſe deceiue themſelues therin: for that beard is nothing elſe, but the fine duſt of the ſtone, hanging together by vertue thereof: which being ſeparated from the ſtone (although it were a right good one) is not able any whit at all to turne a needle of it ſelfe. The triall is ſoone made by this meanes, let them take of that beard from the ſtone with a ſticke, and lay it vpon the end of a needle not touched, and they ſhall finde in it no force at all, nay

it is a hurt vnto the needle. For it giueth a ſuperfluous burthen for a ſmall time, and cannot but incumber his action, by reaſon that euery one of thoſe little parcels of duſt (though beaten out at one end) hath alſo for his ſmall quantity both a *North* and *South* vertue. And therefore marreth as much as it maketh at either end of the needle. The proofe heereof is manifeſt, if you put off that duſt or beard vpon a paper, and hold a Magnet therunder, for as you turne toward the paper the North or South of the ſtone, ſo will euery one of thoſe particles in like ſort turne it ſelfe, ſhewing thereby a double nature.

Chap. X.

Of the faſhioning of the compaſſe needle.

THe Compaſſe needle, being the moſt admirable and vſefull inſtrument of the whole world, is both amongſt ours and other nations for the moſt part, ſo bungerly and abſurdly contriued, as nothing more. And therefore entreating now of the nature and vſe of the Magnet. I haue thought good, alſo, to employ my beſt endeauour, to aduance this noble inſtrument towards his higheſt perfection, being the principall thing, by which the worthy effect of the Magnet, is made moſt profitable vnto mankinde. Heerein fiue things are to be conſidered, the ſubſtance that it is made of, the forme, the waight, the capitell, and the pin it ſtandeth vpon: The ſubſtance

in

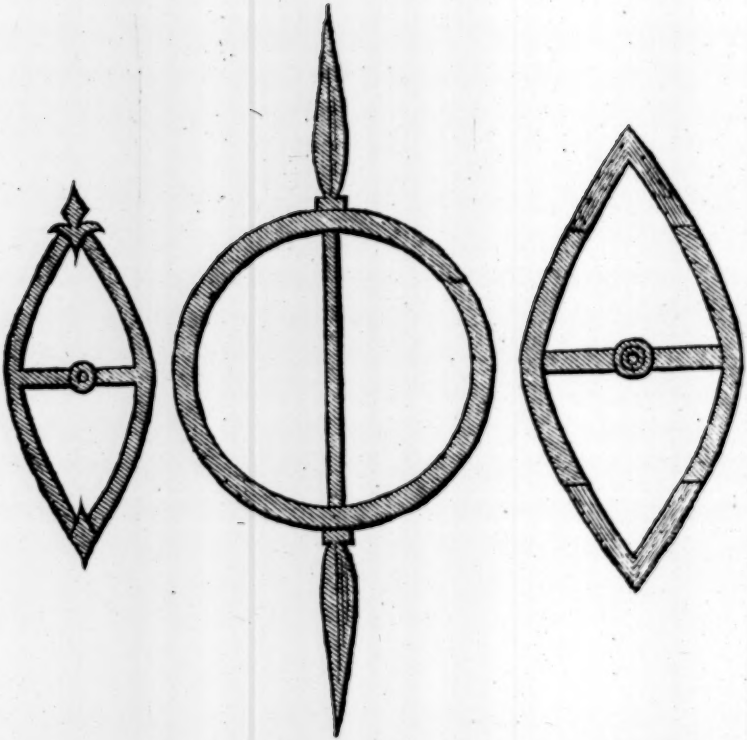
in any wiſe ought to bee pure ſteele, and not iron. For moſt aſſuredly ſteele will take at the leaſt tenne times more vertue then iron can doe, but eſpecially if it hath his right temper. And that is this: Heat it in the fire vntill it be paſt red hot, that it be whitiſh hot and qnench it in cold water ſuddenly: So is it brickle in a manner as glaſſe it ſelfe, and is at that time incapable of the vertue of the *Loadſtone*. Then muſt you, laying it vpon a plaine table, warily rubbe with fine ſand all the blacke cullour from it, if before you put it into the fire, you annoynt it with ſoape, it will ſcale white of it ſelfe, then heat a barre of iron well neere red hot, and holding one end of the needle with a ſmall paire of tongs, lay the other end vpon the hot barre, and preſently you ſhall ſee that end turne from white to a yellowiſh, and after to a blewiſh cullour, then take that end with your tongs, and doe thlik e vnto the other, thruſting it forward vpon the barre vntill the cullour of the whole needle become blewiſh: then throw it on a table, and let coole of it ſelfe: and ſo is he of the excellenteſt temper, and moſt capable to receiue the greateſt power from the Magnet. If this ſeeme too curious eſpecially for ſome faſhions of needles, then vſe but the hammer hardening (as workmen call it) which is well neere as good. As concerning the forme, diuers men are of diuers mindes, ſome vſe a kind of ſquare one, others a loop (I meane an extended ouall forme) and this is moſt common. But now a dayes, a narrow ſtraight plate (being ſomewhat broader in the middle) is in great requeſt: Of theſe three I holde the loope or ouall forme (if it bee well made) to bee the beſt, which is,

that if it be of ſteele, his ends be welded together, hauing a lattin narrow plate, iſſuing from the capitell vnto the middle of the two ſides of the Loope, and there riuetted, and riuetting, if it bee handſomely ſhouldered in by the workman, is better then ſoadering: becauſe, hauing fitted the lattin plate bearing the capitell vnto the Loope, you may firſt put your Loope into his temper, and then riuet this vnto him afterwards, which otherwiſe would bee marred in the fire, and the wide Loope is better then the narrow or the ſtraight plate, and that for two reaſons. The one is, becauſe, as in a Magnet it ſelfe, the force that is in the whole body, ſheweth it ſelfe moſt ſtrongly in his two poles, euen ſo this being a Magneticall body, doth the like in his ends which are his poles: and the ſides of a wide compaſſed Loope (being longer, then of a narrower) of the ſame length, in the *Axis*, muſt needes containe ſo much the more vertue; the other reaſon is, becauſe it ſuppoſeth the flie in his circular motion more equally ballanced then the other: and therefore were it not for ſome other inconueniences, a true circle were beſt of all, which is that except you marke the two places, that you would haue for the North and South, very curiouſly, you ſhall neuer giue him the right touch: yea, very exceeding hardly, although you doe marke them; and alſo the lattin ſtay, that holdeth the capitell, would bee exceding long and a ſuperfluous burden: but the very beſt forme of all (as I take it) in all reſpects is this, a true circle, hauing his Axis going out beyond the circle, at each end narrow and narrower, vnto a reaſonable ſharpe point, and being

pure

pure ſteele as the circle it ſelfe is, haning in the middeſt, a conuenient receptacle to place the capitell in.

This circle muſt haue foure very ſmall holes drilled through it, equally diſtant each from other, for the foure cardinall points, and in both the two poynts, that iſſue without the circle, being for North and South of equall diſtance betweene the circle and the end of the poynt two moe, if it be a large one, otherwiſe one is enough, according vnto this picture following. And this needle is moſt fit to be vſed for the obſeruation of the variation alone without any flie, as I will ſhew at the latter end of this Treatiſe.



Whensoeuer you wil set this needle vnto the fly, you must put the capitell through the center of the flie very precisely, and placing the points of the Diameter where you will haue them, thrust little small pins through the vpper face of the flie, and those small holes in the needle, the heads of the pinnes will shew you (if the flie bee larger then your needle) at what poynt your needle standeth, and bowing the body of your pinnes (being thrust through those little holes) close to the card below, will keep it steddy at that place, and from warping also. And so foure pins at the foure cardinall points will serue the turne.

Againe, if you please for to place this needle vpon the vpper face of the Card according vnto *Steuinius*. it is no more but to haue the capitell loose, thrust thorough the center in the bottome of the flie, and the needle placed and fastened on the top, or vpper face of the carde.

But if you will haue a Magneticall needle to serue onely for one size of a flie, the best way is, insteed of the two pinnes in the ends of the *Axis*, to haue a couple of little halfe staples and a *Flower de luce* on one of them, as you see in the Loope, riuetted there. That in turning about the needle, they may still keep the flie close vnto it, and so fasten it with a skrew vpon the capitell whereseoeuer you please.

As for his waight it must bee according vnto his largenesse, and the waight is one principall cause, that very large compasses are vnprofitable. For the waight of the large carde, and heauy needle, pressing vpon the pinne, will cause the motion of the flie to be dull and vncertaine, and therefore let the past-

board

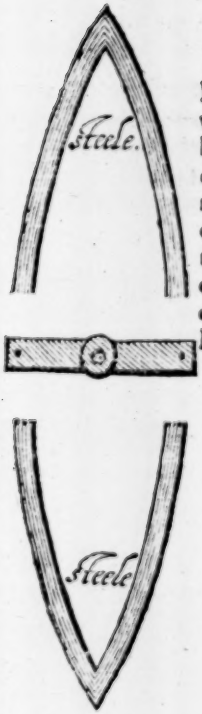
board be no heauier then you muſt needes; and for the ſize of ſixe inches *Diameter* of your paſt-board, and a needle of that length. I know that a needle of halfe an ounce waight, and halfe a quarterne at the vttermoſt (if a good workman haue it in hand) will be very fully ſufficient, of what forme ſoeuer.

The capitell ought to be lattin, and hammer hardned, well and truely boared, not too ſhallow, but of a good conuenient depth and wideneſſe at the bottome, fitting the pinne it ſtandeth vpon at the top. The pinne ought to be either of lattin, or copper, and not of iron or ſteele, as ſome vſe; for they are very ſubiect to ruſt: and the ſteele, eſpecially by long vſe, will weare a little hole in the top of the capitell, and by that meanes the Compaſſe becommeth dull, and they hardly (if euer) will find the reaſon of it; for the hole will bee paſſing ſmall, and entring an exceeding little way in, and yet diſturbeth all. Moreouer, in any wiſe there muſt bee alway an eſpeciall diligent care had of fitneſſe betweene the capitell and the pinne. Oteerwiſe, all things elſe appertaining vnto the compaſſe are nothing worth. This pinne muſt bee very firmely fixed in the iuſt center of the boxe, and the bottome marked, that whenſoeuer you take it off to ſharpen the pin (which vſe will make blunt) you may ſet him in the ſame place againe.

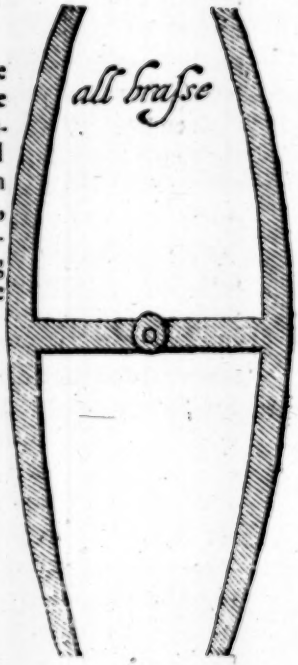
As I haue ſayd that in a Magnet it ſelfe, the vertue is in the whole body, and ſheweth it ſelfe moſt forcible in his poles; euen ſo likewiſe our Compaſſe-needle, being a Magneticall body, ſheweth his force in his ends, which are his poles, although that force doth proceede out of the whole body of the Needle.

Which

Which now I thoght good to make apparant by an euident demonſtration: I cauſed my workeman to make a needle of a Loop faſhion, 8. inches long, or ouall forme in all reſpects fitted to be ſet vnto a flie, ſauing that there was but one inch or a little more at each end of ſteele, all the intermediate part between the two ends, being of braſſe: Theſe two ends I did touch with the North and South ends of a very good Magnet: And whereas in a true Magneticall Needle, I ſhould haue had but two points, the one North and the other South, this Mongrell yeelded me ſix, the two ends adioyning vnto the braſſe of contrary natures vnto the ſharpe points, & would no more doe the office of a Magneticall needle then a woodden ſticke, becauſe the vertue was not in the whole, and ſo communicated vnto the two ends, but each end was a totall of himſelfe, being ſeparated, and (as it were) diuorced, the one from all community with the other by that intermediate braſſe: the which being taken away, and the two forkes ioyned together for that length, preſently they became one perfect true Magneticall Needle, and the vertue of thoſe foure confuſed points, which ere while was was loſt in the forkes, will preſently bee found in the two ſharpe ends, and now his naturall ſeats:



Both these ends of steele were fastened vnto the brasse, and then that needle had no Magneticall motion; but being taken off, and ioyned together, they presently (without any further touching of them) became a true Magneticall Needle.



To conclude this chapter of the Compasse-needle, The needle that is still working vpon his pinne continually will keepe his force better, then that which is otherwise layd vp, although there bee no doubt of the other, for a mans whole age, or longer, if it be of good mettall, and kept from open aire and rust, and from too neere vicinity of iron, but especially of any

Loadstone

Loadſtone. No better keeping from ruſt, then by varniſhing him, although it be but with a drop or two of Linſeed oyle alone; the needle that is continually vpon his pinne, isſtill ſtrengthened by the Magneticall power of the earth, ſetting himſelfe alwayes towards the Poles thereof (which the other cannot doe) and needeth onely to haue his pinne ſharpned now and then: The which of all the faults incident vnto the Compaſſe, is moſt eaſily and ſafely amended. And yet, if it bee not very well looked vnto, it diſturbeth all the operation of the Compaſſe more then any other. And diuers wrong themſelues in being too buſie in often touching of their Compaſſes, the fault being in this which no touching can amend.

Chap. XI.

A Sayling Compaſſe fitted for obſeruing at Sea the variation, amplitude of either ſunne or ſtarres, capes or trendings, &c.

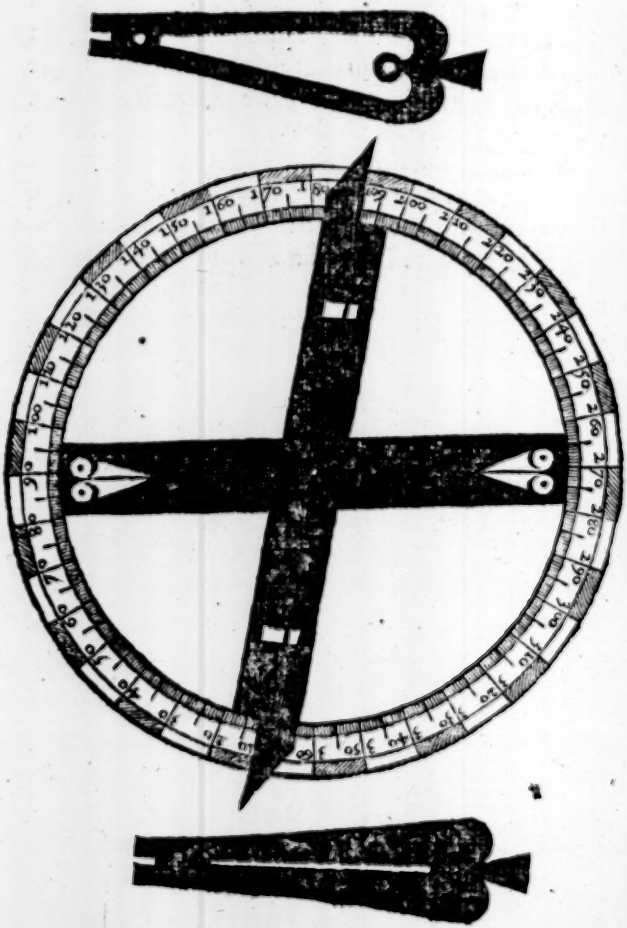
I Haue thought good to conclude this ſhort Treatiſe of Magneticall aduertiſements, with a little additament vnto the ordinary ſayling Compaſſe, fitting him thereby to bee anſwerable vnto the title heere prefixed, as alſo with a compariſon of the ſeuerall vſes, of the Horizontall and inclinatory needles: Let the glaſſe of the inner boxe of the Compaſſe bee of good thickneſſe and ſtrength (but yet

cleere) and euen, thoſe that come from *Venice* for looking glaſſes before the foile be ſet on are the beſt, if a man may haue them large enough. Let this glaſſe be very well fitted vnto the boxe, and ſimmond vnderneath vpon the ſhouldring that beareth vp the glaſſe, with a mixture of waxe, turpentine, ſallet oile and roſin mingled together: or with any other ſimmon as you ſhall thinke good, aboue vpon the glaſſe let there be a ring of thin paſtboard, of the bredth of the ſhouldring vnderneath, in like manner ſimmoned on: then muſt you haue a circle of lattin about the bredth of the paſtboard ring, of conuenient thicknesſe for ſtrength: which muſt bee diuided into degrees: This circle muſt haue a plate of latten, of halfe an inch broad or broader, according vnto the largeneſſe of the circle for ſtrength, that muſt croſſe ouer the middeſt of the circle, cut out of the ſame place with the circle, or elſe ſoadered with ſiluer ſoader: this muſt haue a line all along the middeſt of it, and a little loope at each end cut through the two ends of the loopes being preciſely in that line. Laſt of all, you muſt haue a moueable ruler with two long folding ſights, of about the length of the *Semidiameter* of the circle in bredth about halfe an inch: the one of them muſt haue a ſlit through the length thereof, of about a quarter of an inch broad, as you ſhall thinke conuenient, and two little holes, the one in the top, and the other in the bottome, iuſt in the middle of it, to faſten a ſtring, hauing a very little bead to ſlide vp and downe vpon it. And this ſight muſt be of the thicker ſtuffe then the other. For otherwiſe, becauſe of that which is cut out, it would

be

be ouerpaiſed by the other, and ſo the boxe would ſwarue towards the other; and the ſights muſt each of them haue a little notch in the middeſt of the top of them: this ruler muſt be faſtened (but yet ſo that he may turne about) in the middle of the croſſe plate moſt preciſely in the center of the circle, his ends cut, that he may ſhew the Fiduciall line in the diuiſions of the circle, the other ſight needeth to bee but a a plaine plate, hauing a line in the middle, from the top to the bottome. The deſcription followeth, being the very ſame in ſubſtance with that, which in the *Nauigators Supply*, I call the Compaſſe of variation; although all things eaſier performed with this, then with that,

The Picture.



The Vses.

The Compasse being thus fitted, place the circular needle described in the sixth chapter, vpon his pin alone without any flie. For being disburdened of the card, he will shew his vertue the more strongly, and being of that forme he will ballance himselfe sufficiently.

Place the circle vpon the glasse and pastboard, in such sort that you may turne the circle round about, very close and euen, within the brim of the boxe.

When you will set the same vnto the Compasse, turne the circle about, vntill thorough the Loopes of the middle stay or plate, you see the Axis of the needle right vnder the Fiduciall line of the middle stay, then holding the circle so, turne the mooueable ruler with the stringed sight towards the sunne, vntill the shadow of the string fall vpon the fiduciall line of the moueable ruler, for then doth the end of the ruler, among the degrees, shew the true place or Azimuth of the sunne from the Magneticall Meridian, so that two obseruations, the one in the forenoone, the other in the afternoone, thus made, with the seuerall heights of the Sunne, being one and the very same, halfe the differences of those places of the sun, from the Magneticall needle is the variation.

As for example, if the ends of the ruler did cut forty in the forenoone, and fifty in the afternoone, the difference is then, the halfe therof fiue: so much must the variation be Westward.

If a man haue no exact instrument to take the height

height of the ſunne, hee may make ſome reaſonable ſhift, by ſetting the little bead towards the top of the ſtring, that it may in the forenoone caſt a ſhadow vpon the Fiduciall line of the ruler; and marking that place with any thiug (as inke or blacke lead) in the afternoone attend, vntill the ſhadow of the bead (the bead remaining ſtill where it was) fall vpon that place. For then ſhall you haue that ſame height, if you will take the amplitude of the ſuns riſing or ſetting, ſet the circle, and turne the ruler, as before, vntill the ſhadow of the ſtring do fall vpon the middle line of the other ſight. Then doth the end of the ruler ſhew, how farre the ſunne riſeth or ſetteth from the magneticall Meridian.

When you will take the amplitude of the riſing or ſetting of any ſtarre, you muſt vſe the helpe of another, to holde the circle ouer the needle (as before) and ſo [illegible]rning the ruler, vntill you ſee the ſtarre in his r[illegible]or ſetting, through the two Notches on the tops of the ſights, then doth the end of the ruler ſhew your deſire, The like is to be done in obſeruing any cape, or the trendings of any land for the dedeſcription of any Coaſt.

Chap. XII.

A compariſon of the ſeuerall vſes of the Horizontall and inclinatory Magneticall Needles.

THe Horizontall and inclinatory motions of Magneticall needles are both of them but one

and

and the ſelfe ſame effect of the *Magnet* or *Loadſtone*, the making of the Horizontall or Diall-needle, is among our artificers very well known and triuiall, only they are to be put in minde that they doe alwaies make them of pure ſteele and not of iron. But as for the making of the inclinatory needles, it is a very curious peece of worke: It muſt be of pure ſteele, and in his right temper, the needle and his axis muſt bee at right angles the one with the other, and muſt bee ſo hanged on the two ends of his axis that hee bee very pliant for his motion, and that (before he haue his touch) he bee ſo equally ballanced, that the one end be not one iot heauier then the other, for if it be, all the reſt is in vaine.

When you will vſe the inclinatory inſtrument, thus you muſt doe, hanging him by his little ring, turne him about vntill hee make his leaſt declination (or inclination) vnder the Horizon of the inſtrument: for then is hee iuſt in his Magneticall Meridian, and there ſheweth his due poynt, the which otherwiſe he can neuer do. But here I muſt admoniſh you of two very great errors publiſhed in the contriuing of this noble inſtrument. The one is, that he would haue a little box with an Horizontall Needle faſtened vnto the bottome of the inclinatory inſtrument: for to direct the inſtrument vnto the Magneticall Meridian: and by his picture of the Inſtrument, the diſtance ſhould be but a little more then an inch, where it is impoſſible but that the one needle muſt needes diſturbe the other, ſo that neither of them can ſhew aright, yea, although they were ſix inches aſunder, and more, where the little box will giue little

direction for that purpoſe: and beſides that, it is altogether vnneceſſary, becauſe the inſtrument will finde the Magneticall Meridian, by the leaſt declination of the needle (as is ſhewed before) vnder the Horizon, without the helpe of any other. The other error is this, that he would haue that end of the needle prepared to hang towards the North, to bee framed ſomewhat higher then the other, as is vſuall in Horizontall needles: what workman ſoeuer obſerueth this direction, I will aſſure him, that hee ſhall loſe his labour, and aſſoone hee may waſh a Blackemoore white, as to make ſuch a needle ſerue that turne. The reaſon is, becauſe it is onely the magneticall vertue that worketh this effect, the which ouerwaight, in either end of the needle (in this motion) doth vtterly ouerthrow.

For Horizontall needles in our Northerne Climates, it is neceſſary: but for inclinatory needles, it is vtterly vntrue in all Climates of the whole world whereſoeuer. The motion of the Horizontall needle, is naturally ſtronger then the inclinatory for two cauſes, The one is becauſe his motion is onely ſidewaies, the which is eaſier for the Magneticall motion to worke in, then that which is vp and downe, and that there is no difference which way you place the boxe wherein he ſtandeth, ſo that it bee paralell vnto the Horizon; whereas the inclinatory motion is in a verticall circle vp and downe, and muſt ſtand onely in his Magneticall Meridian to performe his office. The other cauſe is becauſe of the diuerſity of their placing in their boxes: for the Horizontal needle ſtandeth more fitter for his motion, being placed with

with his capitell vpon the poynt of his ſharpe pinne, than the inclinatory can doe, being placed vpon the two ends of his axis, although neuer ſo neere the poynts: But yet he will doe very well, if he be rightly fitted: And for Nauigation vnder either Pole (if there be any paſſage that way) it is the onely Inſtrument of the world. For where the Horizontall needle (or compaſſe) faileth, he is ſtrongeſt, for the neerer the Pole, the ſtronger he is in his Motion, contrariwiſe, it is with the Horizontall needle or compaſſe, for he is ſtrongeſt at the *Æquinoctial*, and of no force vnder the Pole.

The reaſon whereof is this, vnder the *Æquinoctiall* the Horizontall needle ſtandeth paralell vnto the *Axis* of the earth, and is equally ſtrengthened for his motion with the two poles of the earth: but vnder the poles, hee ſtandeth croſſe-wiſe, at right angles with the *Axis*, his center repreſenting the very pole of the earth it ſelfe; ſo that the *Æquinoctiall*, and the Horizon being there all one, if the needle ſhould haue any Horizontall motion there, it muſt needes be an Eaſt or Weſt motion paralell vnto the *Æquinoctiall*, directly contrary vnto nature, and to all Magneticall doctrine.

Yet at the pole, the inclinatory needle is in his cheefeſt ſtrength, framing himſelfe to bee in the ſame direct line with the *Axis* of the earth it ſelfe: ſo that the vicinity of the neereſt pole of the earth, holdeth his conuenient end of the needle moſt ſtrongly, being nothing at all hindered by the aduerſe pole, to affect the vpper (or other) end of the needle. The which in all other ſcituations either more or leſſe it

doth, and eſpecially vnder the *Æquinoctiall*, where each pole affecting his conuenient end of the inclinatory needle, it muſt ſtand very goglingly and vnſteddily for that motion: although moſt ſtrongly for the Horizontall, if you place him accordingly.

Where hence it followeth, that neere the *Æquinoctiall* large compaſſes, and ſmall inclinatories are fitteſt; and neere the poles large inclinatories, and ſmall compaſſes are beſt, for looke vnto what motion the Magneticall force is weakeſt, the ſmaller inſtruments ought for to be applied.

And moreouer, foraſmuch as the Magneticall reuolution of the inclinatory needle, about the globe of the earth maketh his motion for the difference of euery alteration of Latitude neere vnto the *Æquinoctiall*, farre more large & eaſier to be diſcerned, then it can be neere the poles, therefore a leſſe Inſtrument will ſerue the turne there: And becauſe that neere the pole, his motion for differences of Latitudes are exceeding ſmall, and hard to be diſcerned. Therefore very large inſtruments inclinatory are there to bee vſed, eſpecially becauſe the Magneticall ſtrength of the needle for that motion, is there ſo ſtrong and ſteddy, that it maketh ſom recompence for the ſlowneſſe of his mooving. And therefore I ſuppoſe that three in Diameter, will ſerue neere the *Æquinoctiall*, and fifteene neere the *Pole*.

And becauſe this great one may be the leſſe cumberſome, you may cut off the circle at forty and fiue degrees of each ſide of the *Zenith* and *Nadir* of the Inſtruments, and yet leaue the needle ſcope enough, for all Latitudes between ſixty *Degrees* and the *Pole*:

and

and for the the ſteddy ſtanding of the inclinatory inſtrument at the ſea, you may doe thus: about the middle of the inſtrument (or rather ſomwhat aboue the middle) let there be two round pins of braſſe, about three quarters of an inch long, iſſue out; and in a box of a ſayling Compaſſe, the inner circle being taken away, make of each ſide two halfe round notches in the outer circle, there place the Inſtrument vpon thoſe two pins, the which muſt haue towards their ends, littles circles cut in, that they ſlip not out of their rings that they are placed in: then will this Inſtrument ſtand as ſteddy, euen at ſea, as the ſayling compaſſe will doe: for the motion of the inner circle is performed by the turning of thoſe two pins in their notches, and the outer circle is common vnto them both, alwaies remembring that you hang ſome pretty waight in the bottome of the inſtrument, to make his motion more certaine: If the ſhaddowing of the box hinder your ſight from diſcerning the point, that the needle ſtandeth at, it is ſoon holpen with the light of a little waxe candle put downe vnto it: and yet this you ought to vnderſtand as aforeſayd, that the Horizontal and inclinatory motions are but one and the ſelfe ſame effect of the touch of the Loadſtone, and one and the ſelfe ſame needle will very well performe both motions, namely, the inclinatory needle, not the Horizontall, becauſe his placing vpon the pinne maketh him very vnfit for the inclining motion. But the inclinatory needle reſting with one poynt of his *Axis* (the poynts of his *Axis* being very ſharpe) in his little hole, his boxe being placed paralell vnto the Horizon, will performe the Horizontall motion very well. For being placed with the ſharp

point of his *axis* in that hole, it is all one in effect, as the Horizontal is with his capitel on the ſharp point of his pin, but that the one is vpward and the other downward, & yet either of them being as fit for that motion, as the other. Vpon the conſideration hereof, my workman of Wincheſter minding to preſent *Prince Henry* with a rare Inſtrument, contriued an *Æquinoctiall Diall* & an Inclinatory Inſtrument both in one, and one needle to ſerue very well both thoſe turnes. Heerein now appeareth the wonderfull wiſdome of our God, in limitting his times and ſeaſons for the reuealing of theſe wonderfull properties for the vſe of men, in this poore ſtone; namely that aboue 2000. yeeres after that it was knowen and wondred at in the world, for lifting vp of iron (for it was an antiquity in *Platoes* time) the vſe of the Horizontall needle was known, in common vſe, ſcant 200. yeeres agone; and very few yeeres ſince (yea ſcant as yet) the inclinatory is in any common vſe: and who is there that can behold and conſider both theſe vſes, *viz.* both to ſhew the quarters of the world (as *Eaſt*, *Weſt*, *North* and *South*, *&c.*) and alſo the Latitude of the place: to know both theſe in any place of the world, bee the heauens neuer ſo much ouercaſt with clowds, who is he, I ſay, that can beholde theſe two admirable and precious vſes performed, euen with the turning of an hand, the which neither the Grecian Philoſophers, nor the fine-witted Romans, nor the Perſian Magi, nor the Indian Gymnoſophiſts could finde out with all their skill and cunning, but he muſt needs ſay with that Kingly Prophet, *O Lord, our Lord, how great is thy name through all the Earth, who haſt ſet thy glory aboue the Heauens?*

To

To the Worſhipfull my good friend, Mr. *William Barlow* at Eaſton by Wincheſter.

RE*commendations with many thanks for all your paines and courteſies, for your diligence and enquiring, and finding diuers good ſecrets, I pray proceede with double capping your Loadſtone you ſpeake of, I ſhall bee glad to ſee you, as you write, as any man. I will haue any leiſure, if it were a moneth, to conferre with you, you haue ſhewed mee more, and brought more light than any man hath done. Sir, I will commend you to my L. of* Effingham, *there is heere a wiſe learned man, a Secretary of* Venice, *he came ſent by that State, and was honourably receiued by her Maieſty, he brought me a lattin letter from a Gentle-man of* Venice *that is very well learned, whoſe name is* Iohannes Franciſcus Sagredus, *he is a great Magneticall man, and writeth that hee hath conferred with diuers learned men of* Venice, *and with the Readers of* Padua, *and reporteth wonderfull*

derfull liking of my booke, yon ſhall haue a coppy of
he letter: Sir, I purpoſe to adioyne an appeudix of
tx or eight ſheets of paper tu my booke, after a while
I am in hand with it of ſome new inuentions, and I
would haue ſome of your experiments, in your name
and inuention put into it, if you pleaſe, that you may
be knowen for an augmenter of that act. So for this
time in haſte I take my leaue the xiiijth of February,

Your very louing friend,

W. Cilbert.

Faults eſcaped.

IN the Preface ſpeaking of Claudianus: *ſereditical* for *ſideriticall*. fol. 12. lin. 22. *reciprocated* for *riciprocally*. fol. 50. lin. 21. *hangings* for *hugenes*. fol. 53. lin. 16. *as may be*, for *as many be*. fol. 57. lin. 10. *but this is not:* for *this is not*. fol. 68. lin. 19. *ſuppoſeth the fly*, for *ſupporteth the fly*. fol: 79. lin. 11. *ſet the ſame:* for *ſet the Sunne*. item lin. 27. *the difference is then:* for, *the difference is ten*. fol. 82. lin. 8. *higher:* for, *henier*. fol. 84. lin. 26. *three in Diameter:* for, *three inches in Diameter*. fol. 85. lin. 10. *littles circles:* for, *little circles*. The laſt line ſaue one of D. Gilberts letter, *ell:* for, *arte*.

A BREIFE DISCOVERY OF THE IDLE ANIMADVERSIONS OF *MARKE RIDLEY*

Doctor in PHISICKE vpon a Treatiſe entituled,

Magneticall Aduertiſements.

——— *moueat Cornicula riſum*
Furtiuis nudata coloribus ———

LONDON,
Printed by *Edward Griffin* for *Timothy Barlow*,
at the ſigne of *Time* in Paules Church-yard. 1618.

TO THE RIGHT NOBLE AND WORthy minded induſtrious Gentlemen, and others who are any way addicted vnto MAGNETICALL *Knowledge*.

SO it is that for a long time I haue bin greatly delighted in the contemplation of the properties and vertues of this admirable creature of God which we call the *Magnet*, or *Loadſtone*. And as my leiſure and occaſions haue ſerued by conference from time to time, with the skilfulleſt *Nauigators* of our age, by reading all the Treatiſes (as came vnto my knowledge) of ſuch as had written thereof, and therewithall trying by practiſe the truth of thoſe things which I doubted of, and laſtly finding ſome things by my owne experience of good importance by others not at all

mentioned. The cheife of theſe which I iudged profitable for common vſe I did ſet forth in a ſmall Treatiſe intituled *Magneticall Aduertiſements*. And although of mine owne louing affection towards ſuch (as yee are) I haue bin alwaies ready to further you in theſe knowledges the beſt I could, yet I doe aſſure you faithfully, that diuers of good iudgment, learning, and eminent place, (vnto whom I communicated my experiments) very vehemently vrged my publiſhing of them.

A copie of this Treatiſe being by ſtealth written out of my Manuſcript, by one that vnderſtood it not, and by that meanes committed diuers errors, this *Doctor Ridley* deuoured ſome of them, and by his endeuouring to ſquare my propoſitions according to his owne conceipts, and ſo ſuperciliouſly to controll (and cenſure the things which he vnderſtood not) he hath miſſed of the truth very farre and wide, and hath herein wronged both himſelfe, and mee, and his readers, but moſt of all his beleeuers; and yet ſuch is his kinde diſpoſition, that he hath purloyned out of the ſcambled copie of my Treatiſe, for to adorne his owne Treatiſe of *Magneticall bodies and Motions* all theſe that follow; as in his Treatiſe,

Fol. 7. The hilly knobbes, and angulous parts &c. for 17 lines.
Fol. 8. The greater ſtones &c. 5 lines.
Fol. 9. Steele and yron &c. 4 lines.
Fol. 10. The 14. 17. 18. 19. figures are mine.

Fol.

Fol. 18. 19. The 1. 2. 3. 7. waies are mine, the 4. *Doctor Gilberts.*

Fol. 22. Euery part and peece of a Loadſtone, &c. 7 lines.

Fol. 27. If a wyer be touched &c. 5 lines.

Fol. 30. & 31. It is to be obſerued in the faſhion of a Magnet &c. 16 lines.

Fol. 36. For although that naturally &c. 9 lines.

Fol. 51. & 52. Alſo if a Magnet be faſtened &c. 4 lines.

This practiſe is profitable for Trauellers &c. 14 lines moe.

Fol. 63. 64. The beſt way to touch &c. 11 lines.

And ſome haue thought it better &c. 14 lines.

Fol. 66. Set two Loadſtones &c. 3 lines.

Fol. 71. An Adamant doth looſe much of his vertue &c. 3 lines.

Fol. 72. That 20. Chapter (onely a few words chopped and changed) is whole mine.

Fol. 83. And for this cauſe the Adamant &c. 3 lines.

Fol. 89. A peece of Steele well tempered &c. 2 lines.

The two next are his owne, and very abſurd.

Fol. 90. Now it is to be obſerued &c. 10 lines.

Fol. 95. The needles and compaſſes &c. 14. lines.

So that it cannot but ſeeme to any indifferent perſon very ſtrange, that *Doctor Ridley* would publikely ſo traduce mee, and that by name, and ſo con-

temptuouſly in his friuolous *Animaduerſions*, and could neuer hit vpon my name, no not ſo much as once to acknowledge it in all theſe things which he hath by ſtealth learned of mee, and inſerted into his *Magneticall Motions* for his owne, the which with their conſequents if you withdraw from his Treatiſe, you will leaue his motions very dull. For except this *Ridley*, had ploughed with my Heifor, hee had not knowne my Riddle. *Sic vos non vobis.*

In my aduertiſements indeed, I made mention that ſome body had in this manner dealt euilly with mee, and I reproued certaine faults that ſome body had committed, eſpecially in the fundamentall *Magneticall* heare-ſayes of miſnaming of the true North and South, in Magnets and Magneticall bodies, and in making the Inclinatory needle with the one end heauier than the other, and ſome others: But theſe two eſpecially, for becauſe they doe draw on many others, as they doe both in his Booke, and whereſoeuer they ſhall be admitted, they will increaſe like a ſnow-ball, waxing ſtill greater as they goe, and all his dawbing of them with his vntempered morter in his ſilly *Animaduerſions* do amend the matter nothing at all, but make it farre worſe than before. For the common good, I might not let them paſſe vnreproued, and yet I would not publikely name him, but vſed this word ſome body. The like himſelfe hath, *viz.* Some ſay, ſome labour to cleare, ſome thinke &c. in his booke meaning mee, being not contented onely to vſurpe

that

that which was properly mine for his owne (as aforeſaid) but alſo hee tooke vpon him (although very ignorantly) to confute ſome of mine vnder theſe termes, and this onely out of a ſtolne Manuſcript. Whereas all men know that Manu-ſcripts ought to be vncontrould vntill the Author hath publiſhed them, who may alter and change things in the meane ſpace as he thinketh good.

He ſtileth himſelfe principall Phiſition vnto the Emperor of *Ruſſia*, the which many men wonder at, being ſo yong as he than was, and ſuppoſed that he went ouer only as Phiſition vnto our Merchants there, that he ſhould in ſo ſhort a time become that Emperors principall Phiſition. If he were, he ſped better then *Bomelius* did, who is ſaid to haue died there in that cold climat of the extreameſt hot kinde of Calenture.

Out of all queſtion, ſomewhat it is more then ordinarie, that maketh him of ſo hauty a ſpirit, ſo to braue the world with ſuch prodigious aſſertions of his Magneticals, in, and aboue the Moone; the earths Magneticall circular Motions, and his paltry abuſing of the holy ſcriptures to ſupport his lunaticke fictions vnder the name of Magneticall Philoſophie.

There are yet two texts of Scripture, which it is a wonder how they eſcaped him; the one is in *Ioſuah* 10. *ver.* 12. and the other is in *Eſay* 38. *ver.* 8. In the one: That the Sunne and the Moone ſtood ſtill the ſpace of a whole day: The other, that the ſhadow in *Achas* diall went backe 10 degrees,

grees, and the Sunne in the skie returned 10 degrees by the which he was descended.

For it is his guise to make contrary conclusions vnto that which the Scriptures affirme, and therefore blame him not, if he doe so despise *Aristotle*, who neuer taught any such Logicke.

Now therefore that yee may in few words vnderstand the vntruth of the earths *Magnetical Motion*, that is so mainely emblazoned by him, and the weaknes of my *Animaduersors* Magneticall skill, you must know, that the Magneticall Motion is a naturall inclination of two Magnets or Magneticall bodies, that may freely moue, respecting the one the other within the Orbe of their forces with their convenient ends, that is to say, the North end of the one alwaies respecting the South of the other.

If the two Magnets or Magneticall bodies be of like quantitie, forme, and goodnes, their Motions will be of like quicknes of the one towards the other; but if they differ in any of these, their Motions will be so much the slower.

Now forasmuch as all Magneticall motions are alwaies respectiue of the one Magnet or Magneticall bodie towards another, it followeth by necessarie consequent, that no Magnet or Magneticall body, can either moue, or be moued of it selfe, but is vtterly voide of all intrinsecall or selfe-Motion, the true and onely cause of his Motion being euermore without it selfe.

And therfore mine Animaduersors selfe-motion

of

of the Globe of the earth circularly, by Magneticall vigour, in the which hee doth ſo gallantly triumph; is but an idle figment, and a meere *Chimæra*: but his definition of Magneticall bodies is very ſutable vnto it; *viz.* very monſtrous; namely, That wee define to be a Magneticall body, which doth remaine and place it ſelfe in one place, or kinde of ſituation naturall, not alterable, as all ſtarres doe, and the great Regent globes of *Saturne*, *Mars*, *Iupiter*, the *Sunne* and the *Earth* doe: or ſuch, as with reſpect and attendance follow other globes, as the two ſtarres which ſupport *Saturne*; the foure attendants vpon *Iupiter*, lately diſcouered by the truncke-ſpectacle; the two trauerſers about the Sunne, called *Venus* and *Mercury*; and the Moone, which doth follow or goe about the earth, and reſpecteth the ſame alwayes with one Pole, and therefore hath a peculiar Magneticall vertue, that guideth her in this kinde of ſituation.

Auditum admiſſi, riſum teneatis amici.

Any man that conſidereth this goodly definition, being the foundation and ground of his Magneticall diſcourſe, and the very firſt ſentence of his booke, and many the like fancies in his Motions and and Animaduerſions will eaſily diſcerne what his Magneticall skill is, and what a vanity it were for me, to ſpend any precious time to confute in particular ſuch vnreaſonable and ſenſeleſſe opinions, which haue more neede of *Helleborus* to purge them out of his head, then Arguments to confute them in his booke. And in his friuolous animaduerſions

ſeeking to maintaine his former errours, and he being ſo ſnappiſh to haue them amended, hee maketh them ten times worſe then they were before, and far more palpable : But my tetricall Animaduerſor muſt be ruled by reaſon, and affoord all thoſe his patience that do beleeue the holy Scriptures, which flatly doe denie the Earths motion, and affirme the motion of the Sunne, Moone & Stars, in the whole current thereof, as *Pſal.* 19. 6. 104. 5. *Ioſua* 10. 12. 13. 14. *Eſay* 38. 8. *&c.*

Alſo that hee will giue men leaue to credit their ſenſes, in matters ſubiect vnto ſenſe, and not repugnant vnto reaſon ; and that he will not be offended with thoſe who do pitifully laugh at his Magneticall Aſtronomy, with thoſe topſituruy motions, like

Voluitur Ixion, & ſe ſequitur que fugitque.

For although ſome great learned men in thoſe Sciences, haue vſed the ſuppoſed motion of the earth, for an Hypotheſis, ſeruing their ready calculations ; as they haue done alſo their ſuppoſed Epicycles, for the motions of the Planets and their courſes : yet that is no reaſon for to auouch them for to be in themſelues true and reall things, according vnto ſome mens vaine fancies, who doe argue after this ſort.

It is an eaſier matter, and more (as they ſay) agreeable vnto nature, for ſo ſmall a body as the globe of the Earth is in compariſon of the heauens, to mooue circularly in the ſpace of foure and twenty houres, then it is for the huge Vniuerſe ſo to doe ; and that which is done with leſſe hazard, is to bee preferred before

before the like, which may not bee performed without feare of a greater danger, with diuers other reasons like vnto these.

But although such as these are, may goe current in a mechanicall Tradesman shop, yet they are very insufficient to bee allowed for good, by men of learning, and Christians by profession, who know right well, that it is great folly for to oppose that which we call difficult, vnto an omnipotent power, *Who stretcheth out the heauens like a curtaine, and spreadeth them out as a tent to dwell in*, Esay 40.ve.22. *He stretcheth out the North ouer the empty, and hangeth the earth vpon nothing, &c.* Iob 26. ver.7.

And that which we call Nature, it being nothing else but Gods ordinance; there can bee nothing contrary, but all things agreeable vnto nature, which God hath ordained. But God hath ordained the motion of the Sunne, Moone, and Stars (as aforesayd) and the vnmoueableness of the earth; therfore this is more easie, and more agreeable vnto nature; which is preserued onely by obeying Gods ordinance, and heerein onely that consisteth, and hath her being. And that the earths magneticall vertue hath no power at all to performe or help any such motion, as is also before made manifest.

But that mine Animaduersors magneticall skill is ascended vp into our Moone it selfe; yea, and yet higher, farre beyond the Moone, vnto the other Planets and Starres, and into euery one of them, this is such a point of his Magneticall Philosophie, that would make Stupidity it selfe astonished to heare of it.

There was (as the Poets faine) a certaine King of *Phrygia*, that had a gift giuen him of the Gods, at his owne requeſt, that whatſoeuer he touched with his body ſhould be gold, but by that meanes being ready to ſtarue, becauſe his victuals were alſo turned to gold, he entreated earneſtly that he might ſurrender his gift.

It ſeemeth that mine Animaduerſor endeauoureth for to make ſhew, that he hath a ſtranger gift; namely, that by his very lookes (for his lookes, with his Truncke-ſpectacle, are his meanes) he can turne all things to be Magneticall, that hee doth earneſtly behold; He hath ſcowred the Heauens already, euen from the one end vnto the other, that both Planets and Stars are become magneticall in his head; what tumultuous ſtirre may they breed there, no man can tell, it is his ſafeſt way to confine his Magnetiſmes vnto the earth, as their naturall ſeat, and not ſuffer them to clamber vp into the skies, where they haue nothing to doe, leſt that infinite diſperſion of his magneticall knowledge, doe in the end ouercharge his braine, and make him magnetically mad, or at the leaſt to incur the cenſure of him that ſaid,

Delphinum ſiluis appingit, fluctibus aprum.

As therefore whilſt his wits are yet his owne, it is his ſureſt way (like the King of *Phrygia*) to ſurrender that gift againe, to leaue his trifling with the holy Scriptures, and to bee no more a cenſuring Animaduerſor in matters that he hath but ſmall skill in: and that he will heereafter learne to be wiſe vnto ſobriety, *Metiri ſe quemque ſuo modulo ac pede verum eſt.*

eſt. And foraſmuch as his animaduerſions containe nothing at all, of any truth and importance againſt mine Aduertiſements, but onely many ignorant, many wilful miſtakings, contradictions & cauillings, and maintainings of his former abſurdities, the which the more they are ſtirred by him, the more they ſtinke. I will content my ſelfe with this breefe diſcouery of this Animaduerſor, and his animaduerſions, and ſo to leaue him for this time peeping in his truncke-ſpectacle at his celeſtiall magneticall regent globes, with his proud motto:

Non ſufficit orbis.

To try whether he can yet finde vs heere hence any more new glorious dreames, wherby he may either encreaſe the number of the hundred of merry tales, or els augment the noble hiſtory of *Huyn* of *Burgis*.

And whereas he chargeth me opprobriouſly for to haue in my Treatiſe nothing of mine own, but all of other mens, and ſome of his: mine anſwer is, that he knoweth in his owne conſcience (if he haue any) that hee ſpeaketh a manifeſt vntruth, contrary vnto his owne knowledge in both. Yea, I am verily perſwaded, that if he would but giue his owne conſcience, leaue to ſpeake out, it would ring him a tale in his eare vnto this effect: That he himſelfe knoweth right well, that where my knowledge (euen ſuch as it is) in theſe matters faileth: all the ſtore of skill that he hath, cannot aduance it, no not ſo much as one ſtrawes bredth, notwithſtanding all the great countenance hee ſetteth on it, with his ſwelling titles of his Magneticall bodies and motions, and his

Ariſtarchicall cenſuring of my Aduertiſements.

Nil dignum tanto feret hic promiſſor hiatu.

And for my iuſt defence, I will rehearſe but theſe few things (yet ſuch as are of principall importance in this Art) whereas I could name diuers other.

I was the firſt that made the inclinatory inſtrument tranſparant, and to bee vſed pendant, with a glaſſe on both ſides, and a ring on the top, whereas Doctor *Gilberts* hath but of one ſide, and to bee ſet on a foot. And moreouer, I hanged him in a compaſſe box, where with two ounces waight he will be fit for vſe at ſea.

Another is, that I was the firſt that found out and ſhewed the difference betweene iron and ſteele, and their tempers for magneticall vſes, which hath giuen life and quickning, vniuerſally to all magneticall inſtruments whatſoeuer.

I was alſo the firſt that ſhewed the right way of touching magneticall needles.

I was the firſt that found out and ſhewed the peecing and cementing of Loadſtones.

I was the firſt that found out and ſhewed the reaſons why a Loadſtone being double capped, muſt take vp ſo great waight.

Theſe things (yee worthy Gentle-men) haue I mentioned onely to giue you content and ſatisfaction: For although my magneticall knowledge be no manner of way gainefull vnto me, as all that are acquainted with me, know how little I doe eſteeme of it in any ſuch reſpect, yet foraſmuch as I haue publiſhed my Magneticall Aduertiſements of my very

very earneſt affection towards ſuch as yee are, and dedicated them vnto one right worthy Gentle-man of your Society in ſteed of all, euen for your ſakes I could not ſuffer my paines and good will towards you, to be ſo ſcorntully trampled vnder foot (without ſome gaine-ſaying) and pratled out of conceit with cauilling only, and multiplicity of vaine words and peeuiſh brauadoes, The Lord proſper you in all laudable knowledge and vetuous practiſe.

Yours in all hearty affection,

W. BARLOW.